H Hinckley

A
Diſſertation
ON
QUICK-LIME
And
LIME-WATER.

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To the STUDENTS

OF

MATERIA MEDICA.

AS I promiſed in the Winter, Gentlemen, I now put into your Hands, one of the Diſcourſes you then heard on the Simples, conſiderably enlarged; hoping it may be of Uſe to you in your future Practice, eſpecially at Sea.

This Diſſertation on Quick-lime, as well as that on Opium, publiſhed in the fifth Volume of the Medical Eſſays, *clearly ſhew, how much our Knowledge of Medicines may be improven by a few very eaſy Experiments. What Diſcoveries have been made by them on Quick-lime, you have here; and how much the Hiſtory and Effects of Opium have been illuſtrated by them, you cannot have forgotten. However,*

It is not amiſs to obſerve, that ſome Things taken notice of, and clearly proved in that Diſſertation, and there firſt, ſo far as I can yet find, have been remarkably confirmed by later Experiments, particularly the Action of Opium on the Part to which it is applied. Ab Opii gr. iv. Clyſmati additis, æternum dormiviſſe viſus eſt æger. *Vid.* Gaubii lib. de form. *p.* 374. *And Dr* Whytt *found, that although a Frog continued moving its Limbs, turning from Back to Belly, and leaping about for above an Hour after he had cut out its Heart; and was not quite dead after two Hours and a half: yet having injected a Solution of* Opium *into the Stomach and Guts of another Frog, five Minutes after having taken out its Heart, in leſs than half an Hour it ſeemed to be quite dead; and neither pricking, tearing, nor cutting*

ting its Muſcles, cauſed any Contraction in them, or any Motion in the Parts to which they belonged. “ *Since, adds the* Doctor, *in this Frog which was deprived of its Heart, the Parts of the* Opium *could not poſſibly be mixed with the Maſs of Blood, or be conveyed along with it to the Brain; their Effects muſt neceſſarily be deduced from their direct Action upon the Nerves and Fibres of the Organ to which they were immediately applied.*” *Vid.* Eſſay on vital Motion, *p.* 375.

EDINBURGH, Oct. 24.
1752.

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E R R A T A.

Pag.	lin.	
10.	31.	*for* thirty-two, *read* thirty-three.
	32.	*for* thirty-two, *read again* thirty-three.
21.	36.	*for* the ſame, *read* much the ſame.
42.	29	*after* poſſible, *add*, with the ſame Flowers.
53.	*ult.*	*for* Vid. p. *read* Vid. Eſſ. p.

A DISSERTATION ON QUICK-LIME.

QUick-lime, as an external or topical Medicine, was known and much uſed by the ancient *Greeks* and *Romans*; who nevertheleſs, by reaſon of its cauſtic Nature, placed it, with their Arſenics, or yellow and red Orpiment, among the Poiſons, and were ſolicitous only how the Hurt that might be done by it, if taken inwardly, was to be prevented or cured. The Chymiſts of latter Ages boaſt of their having diſcovered a lithontriptic Quality in it, or that ſome of its Preparations did diſſolve the Stone. And *Olaus Borrichious*, in the laſt Century, ſays, he found by repeated Experience, that Shell Lime-water diſſolved Calculi into a Mucilage, if digeſted in it warm for ſome Days. But the Publication of Mrs *Stephens*'s Medicines of late, has put the Learned on making ſuch Experiments and Obſervations as have produced more valuable Diſcoveries; and yet the Subject is not exhauſted. Quick-lime has other Qualities, of no leſs Conſequence in Phyſic, hitherto little known, yea and difficultly believed; but I think demonſtrated in the following Pages.

SECTION I.

Quick-lime, or Calx viva, *is the Lime-ſtone, Chalk, Shells, or any other calcarious Subſtance, ſo calcined in the Fire, as to grow hot in Water, and with Noiſe ſplit, and fall down into a Powder, impregnating that Liquor with as much of* *its diſſolvable Part as it can take up.* For underſtanding this more fully, pleaſe obſerve,

1. That the Lime-ſtone here, is the *Saxum calcis, Agric. Foſſ. l.* 7. *p.* 637. *Saxum calcarium, De Boot.* 522. *Worm.* 45. *Charlet. Foſſ.* 20. *Lapis calcarius, Schrod.* 353. *Lem. Dict.* 101. *Dale* 42. *Geoff.* 1. 77. *Phar. Edinb.* 26. and a Kind of Marble, but not always of the ſame Colour or Solidity, nor equally free of heterogeneous Subſtances. In ſome Places it has the Appearance of a Bed of Shells, whereof the Interſtices and Cavities are filled up with a dark greeniſh brown Marble, as if, in a liquid State, it had been poured upon them; and takes a fine Poliſh. Beſides this Stone,

2. Several other Sorts of Marble, Alabaſter, Gypſum, Chalk, Petrifications, Spars, Shells, *&c.* are calcarious Subſtances; which may be burnt into Quick-lime, though not all with the ſame Degree of Heat, or in the ſame Time. Our Lime-kills burn eight or ten Days, more or leſs, as the Wind blows leſs or more favourably. Much leſs Time ſuffices for Chalk and Shells; and the Calcination of Gypſum, or the Plaiſter-ſtone, according to Dr *Liſter*, is completed in two or three Hours.

Whether the Strength of the Quick-lime is any way proportional to the Degree of Heat, and the Time its Calcination requires; or whether Stone-lime or Shell-lime is the ſtrongeſt, or rather moſt ſtrongly impregnates Water, I cannot poſitively determine. By the Experiments which I have made, there ſeems to be no Difference; but, according to Dr *Whytt*, the Lime-water of the Stone Quick-lime, is not ſo effectual in the Gravel, as the Shell Lime-water *(a)*.

3. Why cold Water heats Quick-lime, is a difficult Problem. For the *Antiperiſtaſis* of the Schools has been long ago exploded; *Van Helmont*'s lixivial alcaline and acid Salts demoliſhing one another, is evidently imaginary *(b)*; and the ſetting at liberty Fire fixed

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(a) Vid. Med. Eſſays, vol. 5. part 2. p. 156. Edit. 1747.

(b) De Lith. c. 3. § 7.

in it, by which not a few of the Learned account for it, did not ſatisfy the great Mr *Boyle (c)*, though he had obſerved that two Drams of Calx vive were increaſed on the Cupel to two Drams twenty-nine Grains *(d)*. And the learned *D. Ludovicus* thus concludes his *Experimenta cum calce viva facta (e). An vero ignearum particularum hic concluſarum fuga (ceu a ſuperiori ſeculo hucuſque permultis viris eruditiſſimis placuit) ſimpliciorive lucta; aut modificata quadam nutritione (quo* Excell. Conringius *inclinavit) aliave elementi primi congregatione contingat, determinatu profecto æque adhuc-dum deprehenditur difficile: nec reſtitantes hinc inde obſcuritates ſatis determinari poſſe videntur, donec etiam de penitiore ignis natura plenius atque planius conſtiterit aut convenerit.* It is well known, that Spirit of Wine, Oil of Vitriol, Filings of Iron, *&c.* grow hot with Water; that a Mixture of Iron, Brimſtone, and Water, takes fire of itſelf; and that the Weight of Lead, Tin, Antimony, is much increaſed by Calcination. But that a ſecond Calcination ſhould have the ſame Effect on Calx vive, is truly ſingular; eſpecially ſince its Weight is not proportionably diminiſhed, however long drenched in much Water; as will afterward appear. I kept half a Dram of Chalk Quick-lime in a red-hot Crucible, full two Hours; and three Hours after weighed it, when it had neither loſt nor gained any thing, but was juſt half a Dram as before. But granting Fire were fixed in Calx vive, and its growing hot in Water, owing to this Fire's being ſet at liberty; yet,

4. The Virtues of Lime-water cannot depend on this Fire. For (a) the Heat is ſoon over, this Fire at liberty, ſoon evaniſhes, without leaving any other Quality behind it, than it does in boiled Water. Beſides (b), if Quick-lime be kept for ſome Time, or not fully calcined, however recent, it produces no Heat in Water; which nevertheleſs it will impregnate with all its Qualities, as well as when it does turn it hot; that is, it will

(c) Mechan. Orig. of Heat, vol. 3. p. 376. Edit. 1744. fol.
(d) Experiments about igneous Particles, *ib.* p. 349.
(e) Ephem. Germ. An. 6. Dec. 1. N. 244. Bib. Pharm. 1. 449.

make as ſtrong Lime-water, though not ſo great a Quantity of it, as if it had been fully and freſhly calcined. (c) The ſecond Lime-water where Heat is never produced, is as ſtrong as the firſt, as will by and by appear. Indeed,

5. It is the common Opinion, that the firſt Lime-water, or the firſt Infuſion of Calx vive in Water, is much ſtronger than the ſecond, and the ſecond than the third; which is mentioned by Mr *Charas (f)*, and I think by him only, and that probably on account of the ſmall Quantity of the Water there uſed; for he orders it to be poured on three or four Pounds of Calx vive, till it ſtand about five or ſix Fingers Breadth above it; and the ſame Quantity of Water to be added a ſecond and a third Time. It has alſo been generally believed, that in order to obtain good Lime-water, the Calx vive muſt not only be recent and fully calcined, but alſo for one Part of Quick-lime, only eight, ten, or, at moſt, twelve Parts of Water taken; as if it could impregnate no more. But Experiments have convinced me, that one Pound of fully-calcined and recent Calx vive, may impregnate ſome hundred Pounds of Water, and as ſtrongly too (ſo far as I could diſcover) as it can eight or ten, however paradoxical this may at firſt appear. For,

6. In *June* 1743, having only ſome Experiments relative to Vegetation in View, I put into a large inverted Bell-glaſs between two and three Pounds of our common Quick-lime, and poured on it twenty Pounds of Water or thereby. In a few Days I got about ten or twelve Pounds of Lime-water pretty clear. So much of the firſt Water remaining in the Lime, it was obvious to conclude, that though I threw into the Veſſel ten or twelve Pounds more of Water, it would ſtill be Lime-water, ſomewhat diluted only. But it appearing to be as ſtrong as the firſt, I filled up the Bell a ſecond Time. And this third Lime-water not being ſenſibly weaker than the firſt, I filled up the Veſſel a third, fourth,

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(f) Phar. Roy. p. 818.

fifth, and I do not know how many Times, as it needed, for more than two Years; during which Time I watered a great Number of Plants in Pots, with this Lime-water only: And yet in *December* 1745, it had the Lime-water Taſte, turned Syrup of Violets green, Vegetable Infuſions yellow, volatiliſed Sal Ammoniac, gathered Cruſts on its Surface, and was as detergent, and no way inferior to the firſt Infuſion. Nor did it appear ſenſibly weaker till Midſummer 1746. But ſoon after, the Lime was quite exhauſted, communicated nothing to the Water, and I threw it out. Having kept in a Pot dry, ſome of the ſame Quick-lime for theſe three Years, and which was in Powder, I put about two Pounds of it, or ſo, into the Bell-glaſs, to ſee how much Lime-water it would afford; and, to my no ſmall Surpriſe, found it could yield none at all, more than it had been clean Sand. This called to Mind an Obſervation of ſome of our Country-people, that the Effects of Lime on Land laſted but three Years. But afterwards I found, that wetted Lime retained its Qualities much longer, I mean the Qualities of Quick-lime; for after theſe are gone or fixed, Lime, or even old Lime Rubbiſh, much improves ſour or ſtiff Grounds. Being employed ſtill in Experiments on Vegetation, I intermitted theſe on Lime for a Year; but reſumed them the Year following. And on

7. *September* the 2d 1747, I put into the ſame Bell-glaſs three Pounds of the common Lime, brought to Town in Powder for building, being ſlaked at the Lime-kills, and poured on it twenty Pounds of Water; and had from it as good Lime-water as from the unſlaked Quick-lime, though neither Heat nor Ebullition enſued on the Mixture; and I think I may ſay a greater Quantity, though I did not uſe it ſo faſt as the former: for I filled it up with twelve Pounds of freſh Water, five times the firſt Year; and how often ſince, I neglected to note down: But to this Day (*September* 13. 1752.) it continues ſtrong Lime-water ſtill. But more exactly,

8. To find how much Water any given Quantity of Quick-lime can impregnate, or how much Lime-water

it may yield? I poured on thirty Grains of Calx vive in a China Bowl, two Gills, or ſeven Ounces three Drams twelve Grains (the Gill containing three Ounces five and a half Drams ſix Grains, or 29. 8. Drams) of Troy Weight. Two Days after, I filtered from it a Gill of Lime-water, and poured on three Gills of freſh Water, filtering it alſo two Days after. This I repeated twice; and had in all ten Gills of Lime-water, from thirty Grains of Quick-lime; that is, five hundred and ninety-two times its own Weight. The fifth Water had nothing of the Lime in it. The Remainder, with the Cruſts in the Filter, being well dried, weighed juſt twenty-two Grains. This muſt appear another Paradox, but will be explained below. The firſt Infuſion was on the 20th, and the laſt on the 27th of *February*. Hence, and from N° 6. and 7. it follows, that Lime retains its Qualities much longer in Water than in the Air, or when wet than when dry; and that Quick-lime may be exhauſted of all that Water can extract from it, be waſhed, or ſweetened in a few Days, if a ſufficient Quantity of Water be uſed, otherwiſe not.

9. I put alſo into the above Bowl a calcined Shell of an Oiſter, of an Ounce Weight, and filled it up with Water. The Shell was not ſo fully calcined, as to fall down into Lime. So ſoon as a Cruſt gathered on the Surface, I poured off the Water, and filled up the Bowl; and this I did to the thirtieth time, when the Water became weak, but not quite free of the Lime. The Bowl can contain about an *Engliſh* Pound of Water. Thus an Ounce of a not fully calcined Shell, yielded about four hundred Ounces of Lime-water, the Bowl not being always quite full. And having filtered and dried what remained, it weighed five Drams fifty Grains, though I ſaved none of the Cruſts. So, to find what Addition they made to the Weight of the Reſiduum,

10. I repeated the Experiment, taking of Chalk calcined in a common Fire ſixty-nine Grains, pouring on it three Gills of Water, and filtering it when it had ſtood a proper Time to ſave the Cruſts. When I had

repeated this ſeven times, the laſt Water was not quite free of the Lime. So even excluding the eighth and laſt three Gills, I had more than ſeventy-ſeven Ounces of Lime-water from ſixty-nine Grains of this Chalk Quick-lime; that is, about five hundred and forty times its own Weight. And the remaining Lime with the Cruſts well dried, weighed ſixty-five Grains, as if there had been but one Grain of the Quick-lime in nineteen Ounces of Lime-water. This muſt at firſt Sight appear altogether inconſiſtent with Truth, Lime-water certainly containing a much greater Proportion of the Lime in it. For

11. Lime-water, however well filtered, expoſed to the Air, in leſs than a Minute's Time throws up on its Surface a Scum, which ſoon becomes a thin Pellicle, tranſparent at firſt, but in a Night's Time or ſo, a white, opake, and very brittle Cruſt, thickening but little afterwards, and never ſubſiding, unleſs it be broken. If this Cruſt be taken off, another will gather, ſo long as there is any Lime in the Water. For when none appears, the Water has no other Effect on Syrup of Violets than common Water: And as the Cruſts gather, the Water becomes weaker. So long therefore as that of which theſe Cruſts are, at leaſt in Part, formed, continues diſſolved in the Water, the Lime-water retains its Qualities, or continues Lime-water, and no longer; although the ſame Cruſts, when formed, have nothing of the Nature of Quick-lime in them; which may be reckoned a fourth Paradox. Now,

12. To find how much of theſe Cruſts Lime-water contains, or can afford, any certain Quantity of it needs only ſtand a few Days in an open wide-mouthed Veſſel, now and then ſtirring the Water, and breaking the Cruſts, until the Water make no Change of the Colour of Syrup of Violets; then filtering the Liquor, and drying the Cruſts. Thus by many repeated Trials on common, Shell, and Chalk Lime-waters, I found (a), that four Gills, or fourteen Ounces ſix Drams and twenty-four Grains of any of them, gave of calcarious Cruſts eleven or eleven and a half Grains; that (b) the firſt Infuſion

did not give more than any ſucceeding Infuſion; the Lime-water N° 7. yielding as much as any of them in *June* 1752; at leaſt that the Difference did not exceed half a Grain; which might be owing to the Circumſtances of the Air at the Time of weighing them, which was always in the Paper through which they were filtered, which gained or loſt ſo much according to the Moiſture or Dryneſs of the Air: and (c) that ſlaking recent Calx vive in Lime-water, did not ſenſibly increaſe the Quantity of theſe calcarious Cruſts. The Lime-water was always filtered through common gray Paper in theſe Experiments. And leſt the Influence of the Air ſhould have weakened the Water during the Filtration, I treated an equal Quantity of unfiltered Lime-water the ſame Way, and had but eleven Grains and a half of Cruſts, as when filtered.

Thus I think the Proportion theſe Cruſts bear to the Water, is with greater Accuracy diſcovered than it can be by Evaporation; becauſe Water evaporated always leaves ſome Earth behind it, ſome more ſome leſs; and without making the Experiment by evaporating the Water by itſelf, it is not poſſible to determine how much of the Reſiduum is this Earth of the Water. And hence probably it is, that a Pint of Lime-water, by Evaporation, afforded Dr *Langriſh* ſixteen Grains of a calcarious Subſtance *(g)*. For even the eleven Grains, or eleven Grains and a half, the moſt that I could obtain from much the ſame Quantity, very much exceed what the Lime loſt in Weight; which muſt be owing either (a) to the Water retained in the waſhed Lime, even after it appeared to be fully dried; or (b) to the terreſtrial Parts of the Water united to the Lime-cruſts; or (c) to the Air, or ſomething attracted from it. For,

13. No Exſiccation, without Calcination, can drive out all the Water from wetted Quick-lime. Hence I found, that a Dram of Calx vive, though three Waters had been taken from it, when fully dried, weighed ſix-

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(g) Vid. Dr *Whytt*'s Eſſay, *l. c.* p. 198.

ty-ſeven Grains, notwithſtanding all the Cruſts were not preſerved. To determine therefore how much Water dried Lime retains, I infuſed for a Night a hundred and twenty-one Grains and a half of recent Chalk Quick-lime in Water; then filtered and dried the Lime fully, which weighed a hundred and fifty-four Grains; that is, was increaſed thirty-two Grains and a half, or more than a fourth Part. Now, allowing that of the ſixty-five Grains, N° 10. of the waſhed Lime, the fourth Part to be adhering Water; this fourth Part being ſixteen and one fourth, or call it ſeventeen Grains, added to the four Grains, which it wanted of the Quick-lime taken, it makes but twenty and one fourth, or twenty-one Grains in all, diſſolved in more than ſeventy-ſeven Ounces of Lime-water, that is, not one Grain in more than three Ounces and a half. Whereas by Experiments, N° 12. every three Ounces of Lime-water yielded more than two Grains of calcarious Cruſts; that is, more than double the Quantity of Lime that ſeems to be diſſolved in it. And allowing to the Cruſts the ſame Proportion of Water we allowed to the waſhed Lime, there will ſtill be more than two Grains of calcarious Matter ſeparable from three Ounces and a half of Lime-water, ſtill double the Quantity of the Lime diſſolved. One half therefore of theſe Cruſts, muſt come either from the terreſtrial Parts of the Water, or from the Air. To diſcover how much the Air contributed to theſe Cruſts,

14. I calcined in a red-hot Crucible for two Hours fifteen Grains of this calcarious Matter, which was thus reduced to eleven Grains and a half; ſo diminiſhed three Grains and a half. I put it again into the Crucible, and ſet it uncovered in a North Window; and after four Days weighed it again, and found it thirteen Grains and a half; ſo had imbibed two Grains. This made me ſuſpect, that I had accidentally loſt ſome of it, ſince probably it could not retain more Water than Quick-lime. Having therefore collected more of theſe Cruſts, I calcined forty-eight Grains of them, and then carefully weighed them, and they were redu-

ced to forty-three Grains; which expoſed to the Air for two Days, weighed forty four Grains. So that in forty-eight Grains of thoſe Cruſts, there were only, at moſt, five Grains of Water; that is, near one half leſs than Lime retains. Hence either they contained no Air, or Fire could not drive it out. As for Water,

15. It is very certain, that there are few Fluids, with which Lime-water can be mixed, from which it does not precipitate ſomething. It precipitates a Solution of Alum, of Borax, of common Salt, of Vitriol, of every volatile or fixed Alcali; every vegetable Infuſion; Urine, Bile, and other animal Fluids; Wines, hard Waters, our Fountain-water, yea and aromatic diſtilled Waters, and tinctured Proof-ſpirits too. I obſerved no Precipitation, on mixing it with acid Spirits, nor with a Solution of Nitre. That terreſtrial Subſtances are in Water, in ſome more, in others leſs, is evident, not only by the many lapideſcent Springs, but alſo by the ſtony Cruſts, with which the inner Surface of Veſſels, wherein Water is commonly boiled, for Inſtance Tea-kettles, is ſoon covered. If from this earthy Subſtance a conſiderable Part of the calcarious Cruſts formed on the Surface of Lime-water is derived, as probably it is, Lime would appear to be a notable Purifier of Water, as it is of many other Subſtances, and to diminiſh its ſpecific Weight: But by any Experiment I could make either with a Glaſs Ball, or by weighing in a thin Glaſs Flaſk, the Lime-water, after it had freed itſelf of all the Lime, was neither ſpecifically heavier nor lighter than the Water of which it was made; though a Flaſk containing thirty-two Ounces and a hundred and five Grains of common Water, contained thirty-two Ounces and a hundred and twenty-five Grains of Lime-water. Nor could I obſerve any Difference betwixt the firſt and the tenth or twentieth Infuſion. Hence the Lime increaſes not the Bulk of the Water in which it is diſſolved. I am very ſenſible, however, how difficult it is to determine ſpecific Gravities accurately *(g)*.

(g) Vid. Phil. Tranſ. N° 488.

16. Although Lime-water expoſed to the open Air, ſoon frees itſelf of all the Lime; yet in a well-corked Bottle it will keep good I do not know how long. I have a Bottle of it twelve Months old, which ſtill taſtes of Lime-water, and greens Syrup of Violets, though I frequently opened the Bottle, and taſted the Water, during that Time. The Air has alſo conſiderable Influence on Calx vive itſelf; in Time fixing it, or quite altering its Nature, and rendering it incapable of communicating any thing to Water, more than Chalk or any abſorbent Earth. How ſoon the Air will thus fix it, if ſpread out thin, I have not tried; but probably not ſo ſoon as is commonly imagined. For I have made good Lime-water of two Years old Quick-lime, and never found it fixed in leſs than a year; and probably in a Bottle it might be kept much longer. But when thus fixed, as well as when all that Water can diſſolve is ſeparated from it, it is as unfit for Mortar as for Lime-water.

17. From the above Experiments and Obſervations, I think may be inferred, (a) That Quick-lime conſiſts of a diſſolvable and an undiſſolvable Part in Water, ſcarcely one third Part being diſſolvable; that is, of three Ounces of Quick-lime, ſcarce one Ounce is thus diſſolvable. (b) That is is but a very ſmall Quantity even of the diſſolvable Part of Calx vive that Water can take up; one Part of Calx vive being ſufficient for five or ſix hundred Parts of Water; that is, one Part of what is diſſolvable, for fifteen or eighteen hundred Parts of Water: So one Pound of good Calx vive, is enough to impregnate an Hogſhead of Water; and how much more, if made in a cloſe Veſſel where no Cruſts are thrown up, I know not, but certainly not a little. (c) That Lime-water made with freſh-made Calx, is not ſtronger than what is made with it, after it is kept ſome Months, if ſufficient Time be allowed the Water to impregnate itſelf: Nor can its Strength be increaſed by ſlaking new-made Lime in it; becauſe it can take up no more of the Lime than it had before. For otherwiſe Water (ſuppoſe a hundred Pounds of it on a Pound of Calx vive) ſtanding many

Days, would be ſtronger than when it ſtands but a few Days, which yet it is not; though the remaining Lime will impregnate equally as much freſh Water ſeveral times. And (d) that Quick-lime ſlaked, as is commonly done at the Lime-kills, is better for the Land as a Manure, than the Quick-lime in Stones, or Shells, as it is called; the imbibed Water, in ſome meaſure, keeping out the Air. And for the ſame Reaſon the ſooner the Lime is tilled down, and mixed with the Earth, it is ſo much the better.

18. According to *D. Ludovicus, l. c.* the Lime-ſtone loſes more than one half of its Weight, when fully burnt to Quick-lime. I found that Chalk loſt above a third by Calcination in a common Fire: But how much Oiſter-ſhells loſe, cannot eaſily be determined, they ſplit and throw off ſo much of their *laminæ* in the Fire.

19. *Dioſcorides (h)* directs how to make Quick-lime of Sea Shells, thus: Cover them ſays he, with Fire, or put them into a burning Furnace for a Night. Next Day, if they be very white throughout, take them out; if not, burn them again, until they become exceeding white. Then having ſlightly dipt them in cold Water, put them into a new earthen Pot, covering it well with Cloaths, and let it ſtand one Night more; and next Morning, all being exactly done, put it up for Uſe. He adds, It is alſo prepared of ſome Sea Stones burned, and of common or baſe Marble, which is reckoned the beſt: And concludes, after giving the Virtues, with obſerving, that recent or newly-made Calx vive, which has never been wetted, is eſteemed the ſtrongeſt. By theſe Directions any body may make Quick-lime of Shells or Chalk. I know Mr *Lemery (i)* is pleaſed to ſay, "that if, after Lime-ſtones are once red-hot, the Fire be not kept up, but the Heat ſuffered to abate, before they are ſufficiently calcined, no ſubſequent Calcination can reduce them to Quick-lime." But this is certainly a Miſtake. For it is the common Practice at the Lime-kills, to recalcine ſuch Stones as do not fall

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(h) l. 5. c. 133. p. 379.

(i) Chym. p. 381. & Dict. p. 101.

down into Lime after the firſt Calcination; which never fails to reduce to Quick-lime all that is calcarious in them. And Shells ſeldom being, in a Chamber-fire, ſufficiently calcined in four or five Hours, ſo as, with Heat and Noiſe, to fall down in Water, I commonly recalcine once, and ſometimes twice or thrice, ſuch half-burnt Shells, before they thus fall down into Lime. But if not calcined white, they give a very bad Taſte to the Water.

20. Whether any Salt can be got from Quick-lime, is controverted ſtill. *Zwelfer (k)*, *Hoffman (l)*, *Lemery (m)*, *Geoffroy (n)*, ſtand for the negative; *Van Helmont*, with ſome other Chymiſts, are for the affirmative: And Mr *du Fay (o)* gives two Proceſſes, whereby he got, he ſays, a true neutral Salt from it. But the Academy in Hiſt. 1732. obſerve, that theſe Operations not ſucceeding with other Chymiſts, they doubted of the Exiſtence of this Salt; and the Diſcovery was difficultly believed. Whereupon Mr *du Fay* gave a third Proceſs, by which he got from Calx vive one Pound, decocted in twelve Pints of diſtilled Water once and again, decanted and evaporated to Dryneſs, ten Grains of an acrid cauſtic Salt: And by uſing more Water, and not diſtilled, he got of Salt two Drams wanting two Grains. How the Chymiſts have reliſhed this Proceſs, I have not heard. That Lime, by means of any Acid, which it may obtain from the Air or other Subſtances, may acquire a ſaline Form, is not to be doubted; but that of itſelf it contains a Salt, ſeems not to be very probable. For,

If there is any Salt in Quick-lime, it muſt be a fixed Salt, having undergone ſuch a Degree of Calcination; and conſequently diſſolvable in Water, and eaſily obtained by Evaporation. But all that Water diſſolves of Calx vive, is nothing but Lime, or a terreſtrial abſorbent Subſtance; and when this is ſeparated in the Form of Cruſts, the Water differs nothing from pure Water; or if the Water be driven off by Evaporation, the very ſame earthy Matter only is left behind; the Water in either caſe neither containing Salt, nor partaking in the leaſt of the Nature of Lime-water. I have indeed ſeen ſeveral ſmall and beautifully-feathered cryſtalline or Salt like Bodies, formed on the Sides of a Phial wherein Stone-lime Water (made of a Pound of Quick-lime, after it had afforded between five and ſix hundred Pounds of Lime-water) boiled down to a fourth Part, had been ſome time kept; alſo in another Phial wherein a Fragment of a Calculus had been infuſed, in the ſame Lime-water, for two Weeks only. I have obſerved them likewiſe in Chalk and Shell Lime Waters, in which Fragments of a Calculus were alſo ſome time ſoaked, in ſmaller Quantities. This cryſtalline Subſtance when dried retains its Figure, but becomes white and opake, but not ſo brittle as the Cruſts. I can diſcover no Taſte in it. I got two Grains of this Subſtance from a Gill of Lime-water, in which twenty Grains of a Calculus had been eight Months infuſed. It did not diſſolve in boiling Water, nor give it any Taſte. Yea, it difficultly diſſolved in diluted Oil of Vitriol; ſo not a Salt, and yet ſomewhat different from the Cruſts. *Ad calcis ſalem, ſpiritum, tincturam, vel oleum quoddam eliciendum, multum inſudarunt chymici; ſed incaſſum: ſi quid enim hujuſmodi extraxerunt, non tam a calce quam ab adjunctis educebatur.* Geoff. M. M. 1. 78.

(k) Ph. Aug. 279.
(l) In Schrod. Manget. 216. Edit. in fol.
(m) Chym. 383.
(n) M. M. 1. 79.
(o) Mem. Acad. an. 1724.

SECT. II.

Quick-lime is abſorbent, antacid, detergent, and cauſtic, ſo not to be taken inwardly in Subſtance; but it is a principal Ingredient in ſeveral potential Cauteries, and in many Soaps.

That Quick-lime comes by theſe Qualities entirely from the Fire, is pretty evident; and I think alſo, that it is more than probable, that they neither depend on any

Salt, nor on actual Fire fixed in it; nor on any more active or more volatile Matter than is the Quick-lime itſelf; but are the neceſſary Conſequence of the Change made on its Parts by the Fire. For the better underſtanding the Nature of this Subſtance, it is not amiſs further to notice,

1. That Quick-lime is too acrid to be taſted; but if ſufficiently weakened or diluted, its Taſte is much akin to that of lixivial and urinous Salts; it has no Smell, unleſs mixed with ammoniacal or animal Salts. Moiſtened, and applied to the Skin, it inflames and corrodes it; yet the Skins of dead Animals ſteeped ſeveral Days in Lime-pits, are not corroded, but only freed of the Hair, and adhering Fat. One of the Ways of preſerving Birds recommended by the very learned and curious Mr *Reaumur*, is by ſtuffing and covering them, either with unſlaked or ſlaked Lime *(p)*. Hence not only the Taſte and Smell of Quick-lime ſeems to be owing more to the Change it makes on animal Salts, than to the Subſtance of the Calx vive, but even its Corroſion alſo. *Corroſio violenta* (ſays *Boerhaave) quæ contingit in corpore viventis, a calce viva illi applicata, magis pendet ab igneis ſalinis ſpiritibus, quos calx viva parit de ſale prius non acri, quam ab ipſo corpore calcis rodente (q).*

2. Quick-lime, whether unſlaked or ſlaked, makes an Ebullition, or efferveſces with, and deſtroys vegetable as well as mineral Acids: And I have once and again obſerved, that ſlaked Lime diſſolved in Spirit of Vinegar diſcovered, if I may uſe that Phraſe, a notable Propenſity to a Kind of Vegetation, ſhooting into pretty curious Figures, very white, not a little reſembling ſome Moſſes, and making the Glaſs in which they grew, appear like a little artificial Grotto.

3. Quick-lime is a very powerful Menſtruum, diſſolving all Sorts of Oil, Greaſe, Gums, Roſines, Brimſtone, animal calculous Concretions, *&c.* ſome of which cannot be diſſolved by lixivial Salts. *Raſura caſei* (ſays

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(p) Phil. Tranſ. N 487. p. 313.
(q) Chem. 2. p. 316.

Van Helmont) *(r) cum arida calce viva liqueſcit, non autem cum alcali cinerum.* This did not ſucceed with me in the common Air without the Aſſiſtance of Water. Mr *Geoffroy (ſ)* obſerves, that if Oil Olive, or any other Huile graſſe, be diſtilled on Calx vive, it becomes much thinner, and, like eſſential Oils, diſſolves entirely and diſappears in Spirit of Wine. " Whereas the vegetable Oil yields to the fixed alcaline Salt of Potaſh-aſh alone, the animal Oil requires the united Force of Lime and Pot-aſh." *D. Hales* Exp. and Obſerv. p. 7. And the *ſulphur præcipitatum Ph. Lond.* or *lac ſulphuris*, is prepared with Calx vive. Hence it does not corrupt or deſtroy Oil, though it diſſolves and purifies it, *Vid. Sapo infra*, N° 16. (a).

4. How much Quick-lime increaſes the diſſolving and corroſive Quality of fixed alcaline Salts, is commonly known. The great *Boerhaave* on the Proceſs of the *ſal acerrimus alcalinus igneus cum calce viva*, remarks thus. *Sal hic ex calcis virtute ignea, vere attracta in alcali fixum igneum, acquiſivit virtutem rodendi acutiſſimam, promptiſſimamque, quæ neque fuerat in alcali ſolo, neque in calce viva ſincera. Hæc acrimonia omnia ſalina nota ſuperat.* And below: *Sal hic, hac præparatione, acquirit hanc ſingularem proprietatem, ut evadat aptiſſimus uniri cum oleis, tam preſſis quam ſtillatitiis, animalium vegetabiliumque, in ſapones: quippe videtur adeo reddi penetrabilis, ut olea hæc intime dividat, ſibique adunet; quod abſque acri hac calce vix commode fieret. Ut etiam, ſine calcis ope non flueret tam facile ad ignem alcali, ſed funditur quam difficillime.* Chem 2. p. 61. Mr *Homberg* has obſerved, that Rock Cryſtal cannot be melted, either by Fire or by the burning Speculum, unleſs it be mixed with Lime, though Lime by itſelf be as little fuſible as Cryſtal *(t)*. Thus Lime ſeems to impart to other Bodies what it has not itſelf; a Quality not eaſily accounted for, nor ſhall I attempt it. Perhaps the following

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(r) De Lithiaſi, c. 3. § 8.
(ſ) Mem. Acad. 1741.
(t) Lem. Dict. p. 178.

Experiments, may throw ſome Light on its Action, on alcaline fixed and volatile Salts.

5. I diſſolved an Ounce of what is called Pearl Potaſh, in three Gills of boiling Water; next Day filtered it through gray Paper; and the *reſiduum* well dried, weighed juſt forty-three Grains. But when two Ounces of this ſame Pot-aſh, and as much pretty recent Stone Quick-lime, were infuſed in ten Ounces of boiling Water, and after two Days Maceration filtered; the *reſiduum*, waſhed once and again, to carry off what Salt remained in it, and well dried, weighed two Ounces ſix Drams and forty Grains. Whence deducing a fifth Part for the Water adhering to the Lime, which is four Drams and thirty-two Grains, there remain two Ounces two Drams and eight Grains undiſſolved; and conſequently one Ounce five Drams and fifty-two Grains only, were extracted by Water, from two Ounces of Pot-aſh, and as much of Calx vive; that is, forty-two Grains leſs, than Water would have diſſolved, of the Pot-aſh by itſelf.

I alſo poured four Gills of cold Water on three Ounces and ſix Drams of Quick lime, and three Ounces and a half of Pot-aſh mixed: And proceeding as above, found, that the cold Water diſſolved of this Mixture (being in all ſeven Ounces and two Drams) three Ounces and half a Dram, (there remaining undiſſolved four Ounces one Dram and a half); which is one Dram leſs than hot Water would have diſſolved of the Pot-aſh by itſelf. So cold Water diſſolved as much of this Mixture proportionally, as hot Water did of the former.

Theſe two Experiments agreeing ſo well, it may be aſked, Whence comes that Quantity of Lime found in Soap-lees? which, according to the Experiments of the learned and accurate Dr *Hales*, amounts to more than a third Part of the dry Salt obtained by Evaporation from theſe Leys *(u)*. Whilſt the learned Chymiſt Mr *Geoffroy*, whom he quotes *(x)*, ſeems to exclude

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(u) Vid. his Account of Exp. *&c.* p. 8.
(x) p. 12.

C Calx

Calx out of the Compoſition of *Alicant* Soap altogether. For, according to him, "In 180 Pounds of Soap, there are 50 Pounds of Salt of Kali, 115 Pounds of Oil of Olives, and 15 Pounds of a watry Humidity." The Action of Calx vive on lixivial Salts noticed below, may help to clear up theſe Difficulties.

6. In order to diſcover what Change the Pot-aſh had made on the remaining waſhed Lime, I infuſed ſeven Drams of it in three Gills of Water; and found it could draw very little from it, ſcarcely taſting of the Lime; which being again dried, wanted not a Grain of ſeven Drams, its former Weight. So that four Gills of Water, with three Ounces and a half of Pot-aſh diſſolved in it, either extract from three Ounces and a half of Quick-lime, more than fifty times that Quantity of Water could do, without the fixed Salt, or fixes it; the Lime not being proportionally, in Appearance, diminiſhed. Again,

I mixed a Spoonful of a not very ſtrong Solution of Pot-aſh with three Spoonfuls of Lime-water: The Mixture inſtantly became white and turbid; ſoon precipitating a white Powder; which being ſeparated by Filtration, and dried, weighed three Grains. The quite clear filtrated Liquor, mixed with eight Spoonfuls of Lime-water, became milky as before. I filtered it fine, and added to it again a Gill more of Lime-water; which had the ſame Effect. This being filtered alſo, I added to it another Gill of Lime-water, which made it as white as ever. I filtered it likewiſe; and having dried what remained in the Paper, it weighed eleven Grains. The clear Liquor felt very ſmooth or ſoapy, and made no viſible Ebullition with Spirit of Vitriol; but mixed with Lime water, it became as milky, and precipitated as plentifully in Appearance as at firſt.

That the Precipitation was chiefly from the fixed Alcali, I think more than probable; becauſe the three Grains of the firſt Precipitation was more than double the Quantity of Lime contained in the three Spoonfuls of Water. Again, two or three Drops of Lime-water falling into a Glaſsful of a Solution of Pot-aſh, turns indeed white at firſt, but divides and ſoon diſappears; the ſmall Precipitation being abſorbed, by the much greater Quantity of the Alcali: But two or three Drops of a Solution of Potaſh, let fall into a Glaſs of Lime-water, not only grow white at firſt, but continue ſo, falling to the Bottom in Form of a white Powder. I might add, Lime-water precipitates diſſolved volatile Salts, which fixed Alcalies do not, as will preſently appear.

Do not then theſe Experiments make it alſo more than probable, that Quick-lime rectifies or acts on alcaline fixed Salts, by ſeparating from them ſome Part of the coarſeſt of their Earth, and ſubſtituting in place thereof its own moſt ſoluble and ſubtile Part, whereby their Strength, as a Menſtruum, is conſiderably increaſed? Thus, Water aſſiſted by a fixed Salt, may diſſolve and retain more of the Calx, than could be done by a much greater Quantity of Water by itſelf, even although the remaining Lime appear to be nothing, or not proportionally diminiſhed; which accounts for a ſeeming Inconſiſtency. I ſaid retain; becauſe a Lee made of Pot-aſh and Quick-lime, expoſed to the Air, does not, like Lime-water, throw up a Scum or Cruſt, nor is weakened by boiling; on the contrary, the more it is boiled down, the ſtronger it is.

7. The Effect of Calx vive on volatile Alcalies is no leſs remarkable. That it ſhould ſet at Liberty the volatile Spirit of Sal Ammoniac, has nothing ſingular in it; ſince this can be done by Chalk, and ſuch like Abſorbents: But that the volatile Spirit diſtilled from Sal Ammoniac, or Urine with Quick-lime, ſhould be more acrid, more volatile, and yet not alcaline, nor reducible to a ſaline or ſolid Form, is the peculiar Effect of the Quick-lime (y). *Cum hinc inde ab authoribus* (ſays the learned *Zwelfer*) *calcem vivam tantopere ad fixationem ſalium volatilium deprædicatam ſcirem, & quod ſal ammoniacum* figeret *(quæ tamen fixatio fucata eſt, uti expertus ſum) frequenter legerem, cum eadem experimen-*

(y) *Vid.* Boerh. Chem. 1. Proceſ. 97. & 105.

ta feci, ipſa ſalibus volatilibus diverſimode, ſed ſecundum artem, addita; aſt ne granum quidem illorum, ex prædicta calce, iterum extrahere potui,——Non tamen deſiiti ulterius inquirere, eo quod viderem aquam calcis vivæ potentem eſſe; quin etiam huic aquæ recenti, ſalia volatilia jungerem; moxque vidi effectum, nimirum ſalium dictorum totalem deſtructionem, & eorum in calcem, vel pulverum inſipidum indiſſolubilem, omni odore & ſapore privatum, igniſque violentiam in poſterum ſtrenue ſuſtinentem, converſionem (z). *Vid.* B. Chem. 2. Proc. 105.

That Salt of Hartſhorn diſſolves entirely in common Water, every body knows; but it cannot be diſſolved in Lime-water, without a conſiderable Precipitation. I put into half a Gill of Lime-water a Dram of Salt of Hartſhorn; it became immediately turbid and milky; precipitating a white Powder; which, being ſeparated by Filtration, and dried, weighed two Grains. The clear Liquor and freſh Lime-water mixed, became again white and precipitated. In a Word, on mixing theſe two Liquors, much the ſame *phenomena* occurred, as on mixing a Ley of Potaſh with Lime-water, related above, N° 6. I ſhall only obſerve, that not only this firſt Mixture ſmelled ſtrong of the volatile Salt, and made a briſk Ebullition with Spirit of Vitriol many Months after they were mixed; but alſo when ſo diluted, that there was not a Dram of volatile Salt in fourteen Ounces of Lime-water filtered clear, it made a viſible though ſmall Ebullition with the ſame Spirit. This precipitating Quality of Lime and Lime-water, and their Action particularly, on alcaline Salts, deſerve to be further proſecuted than I have yet had Time for.

8. It is to the Calx vive, that the Soap-lees owe their power of diſſolving the Calculus, the ſtrongeſt Solution of any fixed Alcali having no ſuch Virtue by itſelf, as Dr *Hales*'s Experiments demonſtate; “ Which Solutions (ſays that learned Gentleman) are probably cauſed by taking out the animal Oil, which is the Band of Union of the Stones, in the ſame manner as

(z) Ph. Aug. p. 279.

the whiting of Linen is performed, by taking out of it the vegetable Oil. And as Linen by being thus deprived of its Oil, is rendered whiter, but has withal its Strength in ſome meaſure impaired; ſo the Calculus, in diſſolving generally, turns white, whatever be the Menſtruum *(a)*." Of this more when we come to conſider Lime-water in particular, § iv. And I ſhall only here obſerve by the by, that

I am much perſuaded, Lime-water, yea and Lime too by itſelf, without Aſhes, might be of great Uſe in bleaching Linens, though it is commonly believed to burn the Cloth. For I ſteeped in Water, with a conſiderable Quantity of Quick-lime in it, an old Linen Rag, with ſome coarſe Packthread and Linen Yarn, for ſix Weeks, without their Strength being ſenſibly impaired: But after other ſix Weeks, the Rag was ſomewhat tenderer than at firſt, but not the Thread. Perhaps ſimple Water would have had the ſame Effect. I know only one Objection againſt the Uſe of Lime in bleaching Linen; and that is, it gives the Cloth a reddiſh or browniſh caſt, not a clear white. But this Whiteneſs can never be given the Linen by Soap and Aſhes. The Influence of the Sun and Air, Acids, *&c.* are neceſſary on that Account. But ſurely the Lime at the Beginning, would much further the freeing it of all that Soap and Aſhes can take out. The Experiment is eaſy and ſafe. But to proceed to the Compoſitions in which Quick-lime is uſed. The firſt I mentioned, is the

9. *Lapis ſepticus, ſeu Cauterium potentiale* Offic.; or, The common Cauſtic. This is a Lixive of Potaſh and Calx vive evaporated, melted, and while warm cut, or formed into ſuch Points, Dice, or other Figures, as are fitteſt for Uſe. Some make the Leys of one Part of Quick-lime, and two Parts of Potaſh; others take equal Parts of each; and no matter which Proportion be choſen, for the Strength of the Cauſtic is the ſame in either Caſe. Here the common Soap-leys is generally uſed.

(a) Exper. & Obſ. p. 6.

Mr *Lemery (b)* obſerves, that ſixteen Ounces of Potaſh, and eight Ounces of Calx vive, will yield only eight Ounces of Cauſtic, though ten or twelve Ounces of Salt may be got from the ſixteen Ounces of Potaſh alone, the Calx retaining much of it. His Potaſh, it ſeems, has not been very good. That the Lime will retain a great deal of the Salt, is very certain, be it good or bad; the more therefore of the Quick-lime is taken, there will be proportionally the leſs of the Cauſtic obtained.

The *Edinburgh* Diſpenſatory Edit. 1722. directed the Lixive to be made *Cineris clavellati & Calcis vivæ ana p. æ.* following the then new *London* Diſpenſatory, which made the *Cauterium potentiale, ſive Lapis ſepticus*, the ſame Way; adding, *Simplicius fieri poteſt ex ſaponis nigri, & calcis vivæ partibus æqualibus commixtis.* Our two ſucceeding Editions keep the ſame Proportions, altering only ſomewhat the Proceſs, with a View to render the Preparation ſtill more corroſive; its chief Excellency conſiſting in its Strength, and in the Suddenneſs of its Operation. And I know no Improvement can be made of it, if it be not the diminiſhing the Quantity of the Quick-lime, for the Reaſon above mentioned; or for the Eaſe of the Operator, following the Directions 1722.

The new *London* Diſpenſatory has thrown out the two Cauſtics of the former one, called *Lapides infernales, ſive ſeptici*; and ſubſtituted in their Place a *Cauſticum commune fortius, & Cauſticum commune mitius*, (which laſt differs little from the *Cauterium ſimplicius* of the former Edition, taking only *Sapo mollis*, in place of *Sapo niger)*, the ſtrongeſt of them being much weaker than that made of Soap-leys. For it is thus ordered: *Lixivium ſaponarium ſupra dictum, coque ad partem quartam; deinde calcem vivam, quæ in pulverem trita, cribrata, & vaſe vitreo ſubere obturato aſſervata fuerit ad plures menſes, huic lixivio, dum adhuc ebullit, inſperge, donec omnem liquorem abſorpſerit, ut fiat paſta, quæ vaſe optime clauſo ſervari*

(b) Chym. p. 388.

debet (c)! Thus tranſlated by Dr *Pemberton (d):* “ Boil to a fourth Part any Quantity of the Soap-leys above deſcribed; then ſprinkle in, while boiling, Lime that has been kept in a Veſſel pretty cloſe ſtopt for ſeveral Months; continue to add this Lime till all the Liquor is abſorbed, and the whole reduced to a Paſte, which is to be kept in a Veſſel well ſtopt.” To which the Doctor ſubjoins this Remark: “ The Deſign of thus keeping the Lime before it is uſed, is, that its Acrimony may be a little abated. This Cauſtic is preferable to that called the *Lapis infernalis,* as it will not liquify like that, by the Moiſture of the Part on which it is applied; and by this means keeps better confined within the Limits in which it is intended to operate.” This therefore is not a literal Tranſlation; yea a Line is omitted, there being no *Engliſh* for *in pulverem trita, cribrata, vitreo, ſubere;* and probably of Deſign. Whether Calx vive corked up in a Bottle, will keep ſeveral Months without falling down into a Powder, I have not tried: But whatever Way it is reduced to a Powder, ſifting it is not unneceſſary; though keeping it ſeveral Months *in vaſe vitreo ſubere obturato* certainly is. For as thus keeping it can have little if any Effect that Way, ſo the leſs it has, it is ſo much the better; the freſheſt Quick-lime, in my humble Opinion, not being too acrid to make it deſerve the Name of *Cauſticum fortius,* which the Reaſon given for preferring it to the *Lapis infernalis* ſeems to confirm. For if it do not liquify by the Moiſture of the Part to which it is applied, it will not be Cauſtic at all; if a ſmall Part of it only and ſlowly liquify, it will be but a more tedious Cauſtic, and conſequently protract the Patient's Sufferings.

Mr *Lewis* in his Tranſlation of our Diſpenſatory *(e),* has complimented us with another Cauſtic, “ which, he ſays, is not only more eaſily prepared, and at leſs Expence, but the Uſe of it is likewiſe free from ſeveral Inconveniencies which unavoidably attend the other,

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(c) Ph. Lond. p. 43.
(d) p. 185.
(e) p. 262.

and the common *Lapis infernalis* of the Shops." It is made of a ſtrong Solution of a fixed alcaline Salt in boiling Water, thickened to a Paſte with freſh ſlaked and ſifted Lime; ſo muſt be weaker than the *London* one made of their Soap-leys. It is certainly a very cheap one; and will not ſpread much on the Part to which it is applied, neither liquifying nor corroding ſoon. I would prefer the *London* one to it; but their *Lapis infernalis* to them both; which, if I be not much miſtaken, will do more in half an Hour, than they in two Hours. They are not like indeed to run in the Air *per deliquium*; ſo will keep without Glaſs Bottles cloſe ſtopped. What I made of both Kinds, though mixed without Heat, turned ſoon hard, but in a few Days became very friable; which makes me think they might be kept in Powder.

10. *Sapo, Sapo albus, ſive Hiſpanicus* Offic. *Sapo albus Hiſpanicus*, Ph. Edin. 19. *Sapo durus ab Hiſpania*, Ph. Lond. 18. *Spaniſh* or *Alicant* Soap, *vulgo Caſtile* Soap, is the corroſive Lixive of Potaſh and Quick-lime intimately united to, and ſweetened by Oil Olive. The Conſequences of this Union, as well as the Manner whereby it is accompliſhed, are too well known to be inſiſted on here; ſo I ſhall only obſerve two or three Things concerning it; as, that

(a) There are many Kinds of Soap, as hard and ſoft, white and black, *&c.* The Lixive is commonly much the ſame in all; but the Oils are not; and to this the Difference is chiefly owing. The common black Soap is made of Fiſh Oil, and ſometimes uſed in Sinapiſms, though a very diſagreeable, and, in my Opinion, not a very uſeful Ingredient. But it is only Soap made of pure Oil Olive, or ſuch like vegetable Oil, that is taken inwardly; and ſuch the *Spaniſh* Soap is ſuppoſed to be. And Mr *Geoffroy* found *(f)*, that two Ounces and two Drams of *Alicant* Soap digeſted for ſome Time in diſtilled Vinegar, gave of very limpid Oil of Olives twelve Drams and fifty-four Grains; that

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(f) Mem. Acad. 1741.

is, more than two thirds of this Soap is pure Oil. And the ſame learned Chymiſt, in a Memoir which he ſent to Dr *Hartley*, obſerves, that, "by pouring a vitriolic Acid into a Decoction of two Ounces of this Soap, he obtained one Ounce three Drams and twenty Grains of Oil of Olives: Which agrees with an Experiment made by Dr *Hartley* to the ſame Purpoſe *(g)*." Hence we ſee, that even boiling Soap-leys cannot corrupt or deſtroy the Nature of Oils: Which confirms the Obſervation, § 2. N° 3. And *quo alcali purius, quoque oleum magis ſincerum, nec odore nec ſopore ingratum, eo ſemper producetur ſapo melior, inque uſus inprimis medicatos pulchrior.*" *Vid.* Boerh. Chem. 2. p. 257. ad 260.

(b) The *Spaniſh* Soap is a mild yet efficacious emollient, detergent, diuretic, and laxative Medicine; of great Uſe in the Gravel, Jaundice, and other Obſtructions in the Viſcera, *&c.*; and outwardly in Pains, ſlight Inflammations, Tumours, and foul Ulcers. It may be given to an Ounce, or two, in ſome Circumſtances.

The detergent Nature of Soap, of which none can be ignorant, intitles it to all theſe Virtues; if it be not its Effects on Gravel-ſtones, of which however, by Dr *Hales* and Dr *Whytt*'s Experiments, it is found to be a very powerful Diſſolvent. But that it may be taken in ſo large a Quantity, we much owe to Mrs *Stephens*'s ſtrange Remedy, which perhaps is the chief Benefit the Public has had by it. I ſaid it may be given, in ſome Circumſtances only, to two Ounces, meaning the Stone: But for the moſt part one Ounce, yea half an Ounce, is enough every Day, even in that Diſeaſe; becauſe it generally, in that Quantity, purges: And what goes off that Way, cannot act on the Stone. The beſt Rule therefore for regulating the Doſe in the Gravel, is, to take ſo much of it as keeps the Belly ſoft, without purging more than the Patient uſed to do in Health.

For the Lixive, of which the Soap is made, Stone Quick-lime is commonly choſen as the ſtrongeſt; next to it the Chalk Quick-lime. How Shell Quick-lime would anſwer, I know not.

(g) *Vid.* Dr *Hales*'s Exper. p. 130.

SECT. III.

The moſt common Preparations of Quick-lime are Calx lota, *and* Lixivium, *or* Aqua calcis.

1. *Calx lota,* or waſhed Lime, is what remains of the Calx vive, after all that Water can diſſolve, is ſeparated; or the indiſſolvable Part of it, by itſelf. It has been generally believed, that Quick-lime three or four Times waſhed, in a ſufficient Quantity of Water, *plane mordacitatis expers conſtituitur, ac ſtrenue abſque mordacitate exſiccat* (*h*); which is very true, if a ſufficient Quantity be uſed, and as many Days allowed to do it in. *Vid.* § 1. N° 6. 7. 8.

In *Zwelfer*'s *Pharmacopœia Auguſtana,* Lime is thus ordered to be waſhed, for the *Unguentum e calce: Calcem vivam ſingulis diebus ſemel lavabis, & in fundo reſidere permittes, atque aquam ſpongia exprimes decem diebus continuis. Deinde aqua roſacea lavabis, & ſiccari ſines. Vid.* p. 344. Of this, with Oil of Roſes and white Wax, the Ointment was made; which was long a famous Epulotic, and deſervedly thought ſo. By the old *London* Diſpenſatory, the *Unguentum de calce* was made of Calx, at leaſt ſeven Times waſhed, but no Time fixed for it. In 1721 it was thrown out. And a falſe Opinion prevailing, *viz.* that ſo many Waſhings rendered the *Calx inſtar terræ mortuæ,* by the ſucceeding Edition of that *Auſburgh* Diſpenſatory, in the 1684, the Number of Lotions is left undetermined. Yea in both theſe Editions there is alſo another Ointment, made of Lime once waſhed, and common Oil only, and commended for Burnings; which, from the Effect of the Oil on the Lime, may probably be concluded to have retained no hurtful Acrimony.

The Lime fully waſhed, is ſtill abſorbent and anta-

(*h*) *Vid.* Galen. Simpl. l. 9.

cid; and the *Cremor calcis*, or Cruſts of Lime-water, ſeem not to be inferior to any of the teſtaceous Powders; but theſe are no better than Chalk externally applied: And this being the Way the *Calx lota* was uſed, its Efficacy depended alone on the ſmall Degree of Acrimony it retained. *Calx lota exſiccat ſine mordacitate, adeoque valet ad contumacia ulcera, v. gr. venerea, uti & ad ambuſta, & alia, quæ non facile curationem admittunt.* Schroder. 353. There is nothing in either malignant, repellent, or adſtringent, which can be ſaid but of a few of the *exſiccantia* or *cicatriſantia*. But it is at preſent in deſuetude, I believe every where.

2. *Aqua calcis, Aqua benedicta, Lixivium calcis*, or Lime-water, is Water impregnated with as much of Calx vive as it can diſſolve, as has been ſufficiently explained above.

The *Lixivium calcis*, or Κονια of the *Greeks*, according to *Galen, l. c.* was the firſt Water in which Quick-lime was waſhed; and in the Opinion of ſome, what *Hippocrates (i)* deſigns by τιτανος ἐν υδατι ὡς μη ἑλκωσης, ordered for the *Alphus* and *Lepra*. But whatever is in this, the oldeſt Author that I have met with, who particularly deſcribes the modern Way of making Lime-water, is *Anſelmus Boetius de Boot*, in his *Gemmarum & Lapidum hiſtoria*, p. 523. thus, ℞ *Calcis vivæ unc.* iii. *Aquæ pluviæ lb.* i. ſs. *M. & ſtent triduo in vaſe, poſtea agita, agitata quieſcat per* 24 *horas in vaſe obturato, deinde coletur per linteum.* For according to *Renodæi Antidotarium (k)*, *Aqua calcis eſt aqua in qua pluries calx exſtincta fuerit.* The *Phar. Bateana* keeps *De Boot*'s Proportions; but the Water is ordered to be boiling hot, and filtered ſo ſoon as it has ſubſided The *Edinburgh* Diſpenſatory agrees with Dr *Bates*, omitting only Filtration. In the *London* Diſpenſatory Edit 1721, the Receipt is, ℞ *Calcis vivæ lb.* i. *affunde aquæ bullientis lb.* xii. *poſt ebullitionem ſubſidat calx, & coletur liquor.* In the laſt Edition, ℞ *Calcis vivæ lb.* i. *Aquæ lb.* xii. *affunde gradatim aquam; poſt ebullitionem ſubſidat calx, & liquor per chartam coletur.*

(i) Pop. 2. ſect. 5.
(k) p. 319.

The *Paris* Diſpenſatory makes a firſt and ſecond, thus: ℞ *Calcis vivæ lb.* i. *ſenſim affunde aquæ communis lb.* x. *poſt ebullitionem completam, & debitam reſidentiam, cola ad uſum. Aqua calcis ſecunda.* ℞ *magma aquæ calcis primæ, affunde aquæ communis lb.* vi. *poſt viginti quatuor horas filtra, & ſerva.* Cod. Medicam. p. 205.

But by many Experiments I have found, that it is altogether indifferent whether the Water be hot or cold, poured on gradually or at once, the Water poured on the Calx, or the Calx thrown into the Water; whether the Calx vive be in Shells or ſlaked, or even expoſed to the Air for ſeveral Months, for ſuch Quantities of the Water as are commonly uſed; and if the Quick-lime be freſh, whether for one Pound of it eight, ten, twenty, fifty, or five hundred Pounds of Water be taken. Only it is neceſſary, even for the firſt Water, after the Ebullition is over, to ſtir and mix the Lime with the Water, and allow it Time to impregnate itſelf; which is beſt known by the Cruſt formed on its Surface. Filtration indeed is not neceſſary, if it be not to prevent any undiſſolved Lime being mixed with it, or Cruſts diminiſhing its beautiful Tranſparency. Some of the Experiments I mentioned, are related above. I ſhall here add an Account of the Way I uſed it, which may confirm ſeveral Things formerly advanced.

3. Having poured about eight Pounds of boiling Water, upon a Pound of Stone Quick-lime in a glaſed earthen Veſſel, I began to drink it the 6th of *July* 1748, taking at leaſt a Pound, or four Gills of it every Day at Dinner, beſides a Gill Morning and Evening frequently. I continued thus to uſe it for ſixteen Months; filling always up the Veſſel, as it needed, with freſh Water, ſometimes hot and ſometimes cold, without obſerving any Difference in the Lime-water, which I conſtantly filtered through gray Paper before I drank it. In *November* 1749, I made ſome Shell Lime-water, and drank ſometimes this and ſometimes the other for eight Months more. Yet in the Beginning of *September* 1750, the Lime was not exhauſted, nor the Water ſenſibly weaker, when it ſtood a ſufficient Time

on the Lime, which I knew, as noticed above, by the Cruſts. But the Lime becoming conſiderably lighter, after it is long thus uſed, for ſome Months it required ſeveral Days to ſubſide, and form the Cruſts: And at length, even after the Cruſts were formed, did not leave one half of the Water clear, that it did at the Beginning; ſo I threw it out, after it had afforded me, I may ſay, ſix hundred Pounds of Lime-water. I ſhall only add, that although I was delivered from the Cauſe of all my Complaints (*viz.* of a Stone an Inch and a Quarter long, and as much round where thickeſt, which had lodged in the Bladder for more than a Year) 27th *May* 1750, having taken of Soap Pills, about half an Ounce, for two or three Days only; yet Lime-water agrees ſo well with me, that I continue the Uſe of it to this Day; taking indifferently that made of Lime-ſtone, or of Chalk, or of Shells, and ſometimes the Lime-water made of all the three together, without being able to diſcover any Difference in their Effects. But ſo much Lime-water is not to be obtained from Quick-lime, unleſs it be freſh, compleatly calcined, and free of heterogeneous Subſtances; for if defective in any of theſe, it will yield proportionally leſs Lime-water.

SECT. IV.

Lime-water is diluent, detergent, antiſeptic, anthelminthic, diuretic, and vulnerary; uſeful in all Diſeaſes proceeding from, or accompanied with Obſtructions in the Bowels or Glands, viſcid Phlegm, calculous Concretions, or Putrefaction; and commended for the Scurvy, Scrophulæ, Gravel, Conſumption, Empyema, Aſthma, Arthritis vaga, Oedematous Swellings, Diabetes, Fluor albus, Fluxes, &c.; and outwardly for Diſeaſes of the Skin, Ulcers, Gangrenes, &c. It may be taken to a Pound once, twice, or thrice a-day, or uſed for common Drink.

This Water, which was long looked on as a Cauſtic,

ſtic *(l)*, has been found of late, and I believe in the laſt Century only, to be a very ſafe and valuable Remedy; and *multum facere in plurimis caſibus epota (m)*. Who firſt ventured to give it inwardly, I know not; but *Willis*, *Bates*, *Morton*, ſeem to have uſed it much. The great *Boerhrave* alſo commends it not a little; but at the ſame time cautions againſt giving it in putrid or putreſcent Diſtempers. *In illo autem ſcorbuto* (ſays he, Chem. 2. 316.) *qui a putrefactio pendet, inque oleo & ſale acri conſiſtit, nocet quam maxime.* And below, *In alcaleſcentibus, bilioſis, ſalinis putridis, reſolutis cum acri, calidis, acutis, nimis jam motis, obeſt.* And it muſt be owned, that this appears, at firſt Sight, to be a natural Inference from the Effects of Quick-lime on Sal Ammoniac, Urine, *&c.* Nevertheleſs I have attributed to Lime-water an antiſeptic Virtue, for ſeveral Reaſons; which, with ſome other Properties of this Liquor not hitherto well known, ſhall be particularly related. I obſerve therefore;

1. That the Taſte of Lime-water does not always appear the ſame, even to the ſame Perſon; making ſometimes a more and ſometimes a leſs pungent Impreſſion, according, to wit, to the Quality of the Saliva at the Time: But generally, to ſuch as are unaccuſtomed to it, it at firſt taſtes ſowemhat acrid and urinous; then notably ſalt or muriatic, eſpecially if ſquirted to and again two three Times through the Teeth; and leaves an agreeable Sweetneſs in the Mouth behind it, which improves the Flavour of any Liquid taken after it. It gives no Smell of itſelf; but mixed with Ammoniacal Salts, it raiſes the volatile Spirit, and ſo muſt ſmell like it.

2. Lime prevents the corrupting of Water; and

(l) *Lixivium velut lotura cineris eſt* (ſays *Paulus*, Prin. Med. l. 7. p. 627.); and below, *Si vero etiam calcem aſſumat cinis, uſtoria vi præditum lixivium facit, quod etiam* Προτοϛακτον *nominant, & medicamentis quæ per clyſterem in ſedem infunduntur maxime miſcetur. Omnium autem fortiſſimum eſt quod ex ſola calce fit.*

(m) *Vid.* Ph. Bateana, p. 6.

how long Lime-water may be kept ſweet, or without ſpoiling, or becoming putrid, I have not found. For the Water in the Bell-glaſs, § i. N° 7. never ſtunk like putrid Water, though Numbers of Hoglice have been killed in it; and any ſimple Water, in two or three Days, in the ſame Green-houſe, becomes pretty fœtid. But I have kept Lime-water in a Bottle more than a Year quite ſweet; as alſo Water, after it had thrown up all the Lime, and was filtered.

3. Lime-water kills Worms, and many other, if not all, Inſects; and that commonly in leſs than half an Hour. For I made the Experiment on Earth-worms, black Snails, Shell Snails, which threw out immediately a great deal of Slime, that became as yellow as Saffron; Caterpillars, *Scolopendræ valde exiles longæ*, R. H. Inſect. 45.; long ſlender Worms taken out of a Cod's Stomach, Ants, Hoglice; which laſt lived an Hour in it. Hence I concluded it might prove a good Anthelminthic for Children. And for a Girl eleven Years old, who for ſeveral Days complained much of Pains in her Stomach, and had ſome other Symptoms of Worms, I ordered a Gill of this Water to be taken, Morning and Evening, for three Days; and then an Infuſion of Sena and Rhubarb. The Directions were followed; no Worms were obſerved to come away; but ſhe was freed of all her Complaints, and has been perfectly well ever ſince, and better coloured. And having communicated this to Dr *Rutherford*, who was then giving *Clinical Colleges* in the Royal Infirmary, he preſcribed it for an old Woman, who had been for a long Time exceſſively troubled with theſe Vermine, and effectually cured her, by Lime-water alone. And ſeveral others ſince have experienced its good Effect that Way.

Hence it is very probable, that Lime-water may be of great Uſe in long Sea-voyages, in preventing the Corruption of their Water, or Inſects breeding in it, as well as curing the Diſeaſes to which Seafaring People are moſt ſubject. The Experiment is certainly ſafe, eaſy, and attended with no Expence; one Pound of freſh well-burnt Calx vive of any Kind, being enough for a Hogſhead of Water: Which may not only be uſed for common Drink by the Diſeaſed, or for Prevention by the Healthy; but alſo, by boiling, and expoſing it to the Air for a ſhort Time, it may be reduced to ſweet Water, and uſed in dreſſing the Victuals of the moſt delicate. Moreover,

4. Lime-water makes no Ebullition with acid Spirits, vegetable or mineral, no Precipitation; though the Cruſts it forms are notably abſorbent. Yet it turns yellow, and precipitates a Solution of corroſive Sublimate; but turns white or milky, Solutions of either volatile or fixed alcaline Salts, which Acids again clarify. When mixed with Syrup of Violets, it gives it a green Colour; but commonly this Colour fades in leſs than an Hour, and turns yellowiſh: Whereas the Water in which Lime kept dry for about two Years was infuſed, and which communicated no other Quality to it that I could diſcover, when a little Syrup of Violets was diſſolved in it, became of a much deeper Green, and did not fade in leſs than ſix Days; neither did it then become yellowiſh, but bluiſh, as if it had been diluted with common Water only. Powdered Chalk has much the ſame Effect on diluted Syrup of Violets. Hence the Virtues of Lime-water do not depend on its Abſorbency; and it may be as juſtly called antalcaline as antacid. This a learned Phyſician, and Friend of mine, confirmed from his own Experience; who being much troubled with a grating Acid in his Stomach, and uſing Lime-water on another Account, found it had no Effect on his Cardialgia.

5. Lime-water prevents, or long protracts the Putrefaction of Animal Subſtances. The 22d *January* 1751, having in one Phial Stone Lime-water, and in another Fountain-water, I put into each a little Bit of freſh Beef, and corked them up. I did not draw the Corks till the 1ſt of *February*, when the Fountain water was become very fœtid, but the Lime-water not in the leaſt tainted. And thus it continued till the 1ſt of *May*, when I took both out. That in the Fountain-water was

corrupted and abominably fœtid; but the other quite ſound, and not at all putrid, more than when put into the Lime-water. There were adhering to the Sides of this Lime-water Phial, numerous little cryſtalline Bodies formerly deſcribed. Which are very different from what *Leeuwenhoek* calls a Salt, in his *Obſervationes de figuris ſalis, p.* 137.—143. Where he gives the Figures of ſome ſmall Particles, of the Lime probably, which his Glaſſes diſcovered, both in Water wherein he put ſome *Calx lapidea quæ Leodio advehitur*; and alſo Water with which he mixed ſome *Calx ex conchis marinis.* But at the ſame Time he notices, that they do not, like other Salts, diſſolve in Water. *Nam quemadmodum* (ſays he) *diverſæ particulæ ſalis, quæ ex cineribus conficiuntur, pleræque omnes minimo humore diſſolvuntur, aut in aquoſam commutantur ſubſtantiam, ſic hæ particulæ ſalis, ex calce provenientes, e contrario in ſummo humore obdurantur ſive rigeſcunt, adeo ut eaſdem rurſus in aquoſum converti humorem nunquam viderim.*

September the 7th I began the ſame Experiment on Fiſh, putting into each of the Phials a Dram Weight of a freſh Haddock; there being in the one five Ounces of Shell Lime-water, and as much Fountain-water in the other. The Fountain-water ſtunk in two Days Time; but the Lime-water ſmelled only of freſh Fiſh, and continued ſo to do till *January* 1752, when it was taken out as ſweet as ever; while that in the common Water was putrid enough, as may eaſily be imagined.

I mixed one Part of filtered ten Months old Herring-brine, which was of a deep reddiſh brown Colour, and very tranſparent, with two Parts of Lime-water. The Mixture became immediately white and turbid, without any obſervable Change of Smell But on adding two Parts more of Lime-water, it ſmelled of the Spirit of Sal Ammoniac. The Mixture precipitated a white mucous Subſtance, and became as clear as Water above: And the volatile Alcali being driven off, it ſmelled only of well and recently cured Herrings. Old ſalted Beef-brine treated the ſame Way, gave the very ſame *phænomena.*

Lime-water has not quite the ſame Effect upon Urine, as on Brine, if we are to judge of its Putrefaction by its pungent Smell. For mixed with the Urine new-made, of a Perſon in perfect Health, it precipitates plentifully a white mucous Subſtance, yet does not increaſe nor alter its Scent for five or ſix Days; nor raiſe from it, in the common Air, any thing like the Spirit of Urine. But ſoon after, the Scent becomes pretty ſtrong, and ſo continues; but ſtill leſs ſo than if no Lime-water had been mixed with it. I mixed Lime-water with the Serum of very ſizy Blood, being taken from a Perſon in a Fever; alſo with Ox-gall, both new and old; with much the ſame Appearances. It is not amiſs however to notice, that the Gall, which had been kept in an open Bottle from *May* 20. to *Auguſt* 3. ſmelled as ſweet as Muſk, though it was formerly fœtid; and being mixed with Lime-water in a Drinking-glaſs, and ſet in a Window, it retained its ſweet Smell till all the Humidity evaporated. The freſh Gall had no Smell, ſtunk in a few Days, and in two or three Months got the muſky Scent by itſelf. But Lime-water neither deſtroyed the Perfume, nor increaſed the *fœtor*; though it gave both a whey Colour, and precipitated ſome *mucus*. Hence I think it follows, that Lime-water is notably antiſeptic; and alſo that,

6. It corrects the marine Salts, not by converting them into a Sort of Sal Ammoniac, or any way volatiliſing them; but by diſengaging or extricating theſe muriatic Salts, in our Juices, from ſuch adhering alcaleſcent or putreſcent Subſtances, as clog and hinder their acting agreeably to their own Nature. For as it is certain that Sea-ſalt never can, either by Lime-water or Quick-lime, be turned into Sal Ammoniac; and, on the contrary, that they, by diſſipating the volatile Spirit of that Salt, rather regenerate a Sea-ſalt: ſo alſo that the Sea-ſalt has been unjuſtly blamed as the Cauſe of ſeveral Diſeaſes of the Skin, of the Scurvy, of the Gravel, &c. its natural Effects ſufficiently evince; and it has been found by Experience, to be rather a Remedy in ſuch Caſes. And this ſeems to be one Way the

Lime-water exerts its antiſeptic Virtue, which the foregoing Experiments prove. And beſides,

If Lime-water were putreſcent, I do not ſee how it could do any good in almoſt any of the Diſeaſes wherein it is moſt commended, and found to be moſt ſucceſsful. Yea, I have often thought, that Quick-lime in the Ship's Well, would effectually prevent the corrupting of the Water, and conſequently the putrid Steams, or foul Air thence ariſing, which proves ſometimes fatal to the poor Men.

7. The Virtues of Lime-water outwardly applied in many Diſeaſes of the Skin, in Excoriations, Ulcers, Gangrenes, *&c.* are well known. It has been called *Chirurgiæ altera manus.* And perhaps there is not a better Gargariſm, for ſeveral Sorts of ſore Mouths and Throats, than Lime-water; which I have known alſo of great Uſe in the Toothach. Inwardly taken,

8. Lime-water has all the Virtues of the pure Element, which are not a few; and on which probably depend, the good Effects of the mineral Waters, more than on the Minerals they contain. Hence at leaſt it is diluent. *Monſ. Lemery (n)* ſays, it commonly cauſes great Thirſt, although, according to him, the Doſe be from one to four Ounces only. But this is contradicted by Experience. It never had any ſuch Effect on me; on the contrary, I found it quenched Thirſt as well as ſimple Water, and Cuſtom has rendered it as agreeable. It is alſo notably detergent and attenuating, yea more detergent than Soap itſelf, of mucous, viſcid, and other animal *Sordes*, which makes it preferable, in many Caſes, to the pureſt, as well as to mineral Waters. In a Word, ſuch are its Effects, that I think Lime-water may be ſaid, in general, to purify the Blood with as good Reaſon, as any one Medicine whatſomever, eſpecially from any putrid, purulent, or ſcorbutic Foulneſs.

9. That Lime-water is lithontriptic, has been demonſtrated ſufficiently by Dr *Hales*, and more fully by Dr *Whytt*. But theſe Experiments having been made

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(n) Chym. p. 386.

with Lime-water of the firſt Infuſion, aſſiſted by an artificial Heat, I thought it might be of ſome Uſe to try the Effect of Lime-water, after fifty or more Infuſions, on Gravel-ſtones, and in the common Air. Wherefore,

In *July*, as I remember, 1750, I put a little Gravel-ſtone, about the Size of a Lentil, into a Glaſs of this old Lime-water, and ſet it in a North Window; and not expecting any ſudden Alteration, took no more Notice of it for ſeveral Days. But in a Week or ſo, it appearing at a Diſtance remarkably bigger than it was at firſt, I took it down, and viewing it through a magnifying Glaſs, obſerved a very remarkable Change of it: for it reſembled nothing ſo much as the round Head of a little Shrub loaden with Snow, which upon ſtirring it, fell down into a moſt ſubtile white Powder; a ſmall Part of the honey-combed Stone remaining undiſſolved. This ſeeming ſomewhat to explain how the Lime-water acts on the Stone, I repeated the Experiment ſeveral times on other ſmall Stones, to diſcover more particularly the Proceſs of this Solution. And, in ſhort,

I obſerved, that ſometimes in one, ſometimes in two or more Days Time, there appeared on the Stones little round white Grains as it were, not ſo big as ſmall Pins Heads, but by the magnifying Glaſs little Balls, as of a very fine *Farina*; which gradually increaſing, both in Size and Number, in a few Days covered all the Surface to a conſiderable but an unequal Thickneſs, and gave the Appearance of the Shrub full of Snow I juſt now mentioned. Hence the terreſtrial or ſolid Parts of the Stone, are not, properly ſpeaking, diſſolved, but only ſeparated. Now, the Stone conſiſting of Earth, Oil, Salt, ſome Water or Phlegm, and much unelaſtic Air, whatever can diſſipate or ſeparate from it any of theſe, will probably alter its Texture, or deſtroy the Coheſion of its Parts, or at leaſt diminiſh the Force by which they cohere. Lime-water, therefore, by volatiliſing the animal Salt, and (if not deſtroying) preventing the Coagulation of volatile Alcalies; or by diſſolving the Oil, or the Phlegm; or by its penetrating

Detergency, ſeparating the ſolid Parts only, may prove lithontriptic.

The Action of this Liquor on animal Salts and volatile Alcalies, ſeems ſufficiently to evince its prophylactic Virtue, in preventing the Generation of the Calculus. But that it thus has Effect on the Stone itſelf, is not ſo evident: For if this was the Caſe, the Stone reduced to Powder by it, would probably be ſenſibly lighter than it was before; which it ſeems not to be, by the following Experiments.

October 19. 1751, I took two Fragments of a Calculus; the one weighed exactly twenty-five Grains, the other being lighter, I added a ſmall Bit of the ſame Stone that made it twenty-five Grains alſo; this I infuſed in a Gill of Shell Lime-water, and the former in as much Chalk Lime-water, in ſeparate Phials, cloſe corked. The 12th *May* 1752, I filtered both, dried well the *reſiduums*; each of which weighed juſt twenty-five Grains, as at firſt. I then ſeparated from what continued ſolid, all that was in fine Powder, or very friable; and the ſolid Part remaining of the Fragments in the Shell Lime-water, weighed fifteen Grains; of the other, ſeventeen Grains. Whether the Difference was owing to the greater diſſolving Power of the Shell Lime-water, or to there being in it two Fragments, and but one in the other, and conſequently leſs Surface expoſed to the Menſtruum, this Experiment does not determine. I therefore reduced the Fragment of ſeventeen Grains to fifteen Grains, put them into their reſpective Phials, in which were freſh Lime-waters of the ſame Kinds as above; and after three Months I filtered, and dried, and weighed what remained, or did not paſs the Filter, and had of each fifteen Grains as before. But the corroded very friable Parts being ſeparated, the Fragment of the Shell Lime-water weighed twelve Grains and a half, and the other twelve Grains only. I reduced the remaining Fragments to ten Grains each, and again infuſed them in their reſpective Lime-waters; the Shell Lime-water having had, the preceeding Day, three Oiſter-ſhells newly calcined put into it: And after twenty-eight Days filtered, and weighed them when dry, and had of each ten Grains; from which having bruſhed off what was very friable, each weighed nine Grains: And both together being calcined in a Crucible for two Hours, were reduced to five Grains of a chymical Earth. Hence no Lime adhered to the Calculi *(o)*. And therefore the Energy of the Lime-water probably conſiſts in its penetrating Detergency, whereby inſinuating itſelf among the ſolid Parts of the Calculi, or into their Pores, it ſeparates them, or diminiſhes their Coheſion, but does not diſſolve them: Much the ſame Way as acid Spirits act upon Antimony in a higher Degree.

But there being ſome Calculi much more ſolid than others, yea ſome Coats of the ſame Calculus more firm and impenetrable than others, the Action of Lime-water on them, is neither ſo ſudden nor ſo obſervable. I have kept ſome Fragments in it for ſeveral Weeks, with little Effect: On others it acted more on the inner Coats than on the outer one; and ſome it whitened only a little, and made the Surface ſomewhat more friable. However, generally, it raiſed on them ſome ſmall round whitiſh Excreſcences; which ſometimes reſembled in Form and Conſiſtence little Muſhroms, eſpecially the firſt Time that they were infuſed. And, ſo far as I have obſerved, it acted more eaſily on the Calculi of old People than of young; on ſuch as were of a clay Colour, than on ſuch as were more white, or of a darker brown Colour.

10. Since there is but a very ſmall Proportion of Lime in the Water, it may be thought, that taking a few Grains of the Quick-lime in Subſtance, would prove much more effectual in the Stone, than large Quantities of the Lime-water. But this is evidently a Miſtake. For ſuppoſing any Quantity you pleaſe, could be ſafely lodged in the Stomach or Guts, only what Water diſſolves can enter the Lacteals; and though Plenty of Water were taken above it, it could diſſolve

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(o) *Vid. Hales*'s Stat. 2. 191.

no more there than Water can take up, or than there is diſſolved in Lime-water; yea not ſo much, unleſs we could detain the Water ſo long on the Lime, as is neceſſary ſufficiently to impregnate it; and how that can be done, I know not.

Hence Mrs *Stephens* her Egg-ſhells and Snail-ſhells, (the Snails being abſolutely uſeleſs), if burnt to Quick-lime, how much Pain ſoever they may cauſe, can never be equally ſucceſsful with Lime-water in the Stone. And if they be calcined only to a gray Colour, they yield little or nothing to Water, even when long infuſed in it. I attempted to calcine about a Dozen of Egg-ſhells in an open Crucible, keeping it red-hot for five or ſix Hours; and a very few ſmall Bits, near the Sides and Bottom, only being white, I repeated the Calcination; yet, after all, not the fourth Part was become white. I poured Water on them; but neither Heat nor Ebullition enſued, nor did they fall into Lime. In two Days however a Cruſt formed on the Surface, and the Water was impregnated, but had a foreign diſagreeably burnt Taſte. So it will require a very ſtrong Fire to calcine ſuch a Quantity as ſhe directs, to Whiteneſs, in a covered Crucible, in eight Hours Time. And of all the calcarious Subſtances that I know, Egg-ſhells ſeem to promiſe leaſt, any thing of a lithontriptic Virtue, as ſhe orders them.

11. As for the *aquæ benedictæ compoſitæ*, they are not to be compared with the ſimple Lime-water in the Gravel, nor, in my Opinion, in any Diſeaſe requiring it. For, ſo far as I can yet find, there is nothing that can with Safety be mixed or taken with it, that any way increaſes its lithontriptic Virtue, Soap only excepted; though many Things diminiſh it, yea quite enervate it as a Medicine; of which Number I reckon Liquorice, Guajac, Saſſafras, which by their Oil, Mucilage, or Acidity, ſo ſheath, or blunt its moſt penetrating Parts, on the Subtility of which its Virtues depend, as to render them quite unactive. I could not therefore but be ſurpriſed, when I read in a late Hiſtory of the *Materia Medica*, that " ſimple Lime-water is principally intend-

ed for waſhing old Ulcers, and other external Purpoſes. When it is to be taken internally, the following Additions are made to it, (he means, the compound Waters are uſed), to take off its ill Flavour, or to add to its Virtues." For even with regard to its ill Flavour, as he calls it, I know nothing but Cuſtom can take it off, or improve it without diminiſhing its Virtue, as do every acid and fermented Liquor. Pyrmont-water makes it more palatable, but weakens it: And to me Sugar makes it worſe, Tea nauſeous, and Saſſafras abominable.

Thus I have finiſhed what I deſigned on Calx vive. But ſome curious Experiments and Obſervations, being lately publiſhed by two very learned and experienced Phyſicians, and my particular Friends, which do not in every thing agree with what is above advanced; I cannot conclude without endeavouring to diſcover where the Miſtakes lie, and to correct them if I have fallen into any. To criticiſe on the Writings of others, is no leſs an invidious Taſk, than to me a diſagreeable one; and far from being the Deſign of the following Lines, which is only to ſhew, that I have advanced nothing without ſuch Reaſons as appeared to me convincing. And I perſuade myſelf, that nothing can be more acceptable to us all, than to be delivered from Errors, and confirmed in uſeful Truths. *Licet amicus Plato, amicus Socrates, magis tamen amica veritas.*

I. Dr *John Pringle*, who was Phyſician-General to the Forces in *Flanders*, *&c.* during the late War, has publiſhed Obſervations on the Diſeaſes of the Army, with an Appendix, containing a great Variety of Experiments relative to Putrefaction: And here, p. 395. he ſays, " To this Examination of Chalk and the Teſtacea, were added ſome Experiments upon Lime-water, made both of common Lime and Oiſter-ſhells: And I found, that Fleſh infuſed in either, immediately ſent forth a diſagreeable Smell, as in a common Ley; (a) yet it did not become putrid till after the Standard: So that, in this Trial, Lime-water made ſome ſmall Reſiſtance to Putrefaction, though the Materials, Chalk and Shells, are both Septics. Nevertheleſs I have obſerved, that when the Putrefaction began, it became always much more offenſive in this, than in common Water (b). And it will afterwards appear probable, that the Virtues of this Medicine do not conſiſt in correcting Putrefaction; but, on the contrary, in checking immoderate Acidities, the Cauſe of many chronical Diſorders (c)." And I have the Misfortune to differ from him in every Article. For

(a) The 2d of *May* 1752, the Spirit being twelve Degrees above temperate, as marked in Mr *Fouler*'s Thermometer, I took three Drinking-glaſſes, filling one of them with Lime-water, another with a Solution of Potaſh, and the third with a pretty ſtrong Soap-ley; and put into each a Bit of a Lamb's Lights raw, and of a boiled Liver; in order to obſerve whether any of them "ſent forth a diſagreeable Smell." But none of them gave any ſuch Smell, either immediately or after twenty-four Hours Maceration, more than the Leys themſelves did, before theſe two pretty putreſcent animal Subſtances were infuſed in them. Neither did I ever obſerve, that either Fleſh or Fiſh, or any animal Subſtance, not of itſelf putrid, or ammoniacal, gave any other Smell than what they did before, on being infuſed in Lime-water. One Thing occurred on making this Experiment, which deſerves to be noticed; and that is, the Liver ſunk immediately to the Bottom in the Soap-leys, but not for ſeveral Hours in the Solution of Potaſh; not certainly by reaſon of its ſpecific Gravity, for the Soap-leys was not lighter; but becauſe *calce viva redditur adeo penetrabilis*, as the great *Boerhaave* ſpeaks. Hence alſo, both Liver and Lights were almoſt quite conſumed in it in one Day's Time, and without Heat, though only contracted and hardened in the Solution of the Potaſh, and a very little blanched in the Lime-water.

In what Degree of Heat the Doctor made his Experiments, he does not mention here. If the Heat of the Lamp-furnace made Fleſh immediately ſmell diſagreeably, I cannot help thinking it was putrid before it was put into the Lime-water; or that that Method is not the beſt Way of determining the antiſeptic or ſeptic Powers of different Bodies. And I the rather incline to think ſo; becauſe I find numbered among his Antiſeptics, ſome Subſtances which are of themſelves putreſcent in a high Degree; I mean Cabbage and other Coleworts. How ſoon theſe putrify of themſelves, and how noiſomely fœtid the Water in which they are boiled becomes almoſt immediately, is commonly known. Yea, if any Colewort be eaten raw, the *Ructus* it occaſions, the Taint it gives the *Saliva*, the Urine, *&c.* in my humble Opinion, ſufficiently prove it naturally putreſcent. And I always took Garlick, Onions, Turneps, Horſe-radiſh, to be of the ſame Kind; but neither Carrots nor Celery *(p)*.

(b) Although by renewing the Lime-water on it, I believe Fleſh might be preſerved from Corruption, I do not know how long; and the ſame Lime-water I found prevented Corruption more than three Months; yet it is not to be expected, that it would never become fœtid. But that "when the Putrefaction began, it became much more offenſive in this than in common Water," is what I never obſerved, but rather the contrary, in every Experiment I made; and particularly in the following one.

April 20. 1752. I poured into one Phial a Gill of Chalk Lime-water, and into another as much of an Infuſion of Camomile Flowers in Water, made as ſtrong as poſſible; and put into each a Dram Weight of freſh Salmon. The Infuſion was very fine and tranſparent, and of the Colour of a Tincture of Aloes. *April* 24. it was become turbid, ſomewhat fœtid, and had ſome mouldy Spots on its Surface. *Aprile* 28. more turbid, ſtill fœtid, mouldy Spots gone. *May* 1. it ſmelled leſs fœtidly, and more of Camomile; the Smell of the Flowers much leſſening, and ſometimes as it were overcoming the *fœtor*. After five or ſix Weeks, the Scent became more diſagreeable; the Infuſion precipitated a

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(p) Vid. App. p. 389.

good deal of ſlimy Stuff, but continued turbid. After they had ſtood macerating for ſixty-eight Days, I took both out. That which was in the Infuſion, was of a dark brown Colour, very tender and fœtid; neither Colour, Smell, Taſte, nor Conſiſtence of Salmon remaining: Whereas the Piece that was in the Lime-water, was quite ſound, retaining its proper Taſte, Smell, Conſiſtence, and Colour; being ſtill reddiſh, and only a little blanched, but not in the leaſt fœtid. When I had kept both Liquors about ſix Weeks longer, and the Lime-water began to ſtink, I filtered both; and obſerved, that the Putrefaction of the Infuſion was much more offenſive than that of the Lime-water. And having mixed one Part of this fœtid Lime-water with two Parts of freſh Lime-water, obſerved alſo, though the Mixture was in a cloſe corked Phial, that in a Day's Time it loſt its *fœtor*, retaining only a fiſhy Smell, which ſome compared to that of Crabs, others to that of Lobſters. If therefore Lime-water is more antiſeptic than a ſtrong Infuſion of Camomile Flowers, I leave it to my Friend to judge, whether it makes only "ſome ſmall Reſiſtance to Putrefaction."

I never thought the Virtues of Lime-water conſiſted only in correcting Putrefaction; but I was very glad to find that it had that Quality; and conſequently was perfectly ſafe in ſuch Caſes, wherein otherwiſe it might have been hurtful, and was generally reckoned ſo. And it gave me great Pleaſure to obſerve, that a ſmall Quantity of Quick-lime could prevent the Corruption of a great deal of common Water; and conſequently be ſignally uſeful to Mariners in long Voyages, by contributing ſeveral Ways to the Health of that valuable Part of Mankind, on which the Proſperity of the Nation not a little depends, and for whoſe ſake chiefly I have publiſhed this Paper.

Neither do I attribute the good Effect of Lime-water in Dyſenteries, putrid Scurvies, internal Ulcers, *&c.* ſo much to its antiſeptic Virtue, as to its penetrating, detergent, and diuretic Qualities; whereby it aſſiſts Nature to concoct and throw off what theſe Diſeaſes had rendered morbid, or, if you pleaſe, corrupted. For I believe it hard to prove, that the Diſtempers moſt commonly called putrid, proceed from a previous Corruption either of the Fluids or Solids, and not the Corruption from the Diſeaſes: It having been always my Opinion, that Putrefaction is more commonly (if not always) the Effect of the Diſeaſes, than their Cauſe: Which might be illuſtrated by the Hiſtory of the Small Pox, peſtilential Fevers, Poiſons, venomous Bites, yea of every infectious as well as putrid Diſtemper, were this a proper Place for it. But I cannot help obſerving, that my learned Friend ſeems to take Putrefaction in too large a Senſe, when he ſays, " We know that neither animal nor vegetable Subſtances can become Aliment, without undergoing ſome Degree of Putrefaction. Many Diſtempers proceed from a Deficiency of this Action. The Criſis of Fevers ſeems to depend upon it, and even animal Heat." *App. p.* 386. For I believe it will be found, that many animal as well as vegetable Subſtances, yield Aliment or nouriſhing Juices, without any Degree of Putrefaction; that the Chyle of healthy People is not putrid; that ſome Animals may be nouriſhed by Subſtances more putrid than their own Juices, and ſo in turning them to Aliment, muſt correct their Putrefaction; and that others which live on Antiſeptics, are notwithſtanding putreſcent themſelves in ſome Degree, at leaſt when dead. In a Word, ſince every antiſeptic Vegetable has a Power of changing the common Juices of the Earth into its own Nature, without any Degree of Putrefaction, I do not ſee why Animals may not have the ſame Power. As for the Diſtempers which proceed from a Deficiency of Putrefaction, I own myſelf ignorant of them; and alſo how the Criſis of Fevers depends upon it, if whatever attenuates, diſſolves, corrects Acrimony, or alters the morbid Qualities of what is preternatural in theſe Diſeaſes, is not included in that Term, or acts by putrifying: And if ſo, Lime-water may be ſaid to putrify the Stone, and *Aqua fortis* Silver. And if we can be nouriſhed without Putrefaction, on, and Cadavers putrify much faſter than living Bodies, how animal Heat depends on it, I cannot conceive.

(c) That the Virtues of Lime-water do not conſiſt in checking immoderate Acidities, is ſufficiently proven above, particularly § 4. N° 4.; and alſo that it really corrects Putrefaction, *ib.* N° 5. But below the Doctor allows it another Quality than any I have aſſigned it: For, p. 415. he ſays,

"Lime-water neither retards Fermentation like the lixivial Salts, nor haſtens it, nor makes it ſo violent as do the Teſtacea; and being beſides of an aſtringent Nature, it becomes an excellent Medicine for ſuch as have weak Stomachs, with a predominating Acid; as many have experienced that were ſubject to the Gout, Gravel, or other Diſeaſes that ſeemed depending on that Cauſe."

I have made no Experiments with it on Fermentation; but from the Doctor's it appears neither to act like lixivial Salts nor the Teſtacea, which much more ſtrongly check Acidities. It is true, the calcarious Cruſts it throws up, are evidently abſorbent, and check Acidities as well as Chalk; and alſo that the Virtues of Lime-water depend on this, ſo long as it continues in its diſſolved State. But as it throws up few or none, unleſs expoſed to the Air, as they have none of the Qualities of Lime-water, nor can ever after be diſſolved in it, and Lime-water makes no Ebullition with Acids; ſo I can attribute to theſe Lime-cruſts only, the Virtues of the Teſtacea, in whoſe Place they may be ſubſtituted ſafely.

Since Lime-water feels ſoft and ſoapy, and neither thickens the Fluids, nor contracts or hardens the Solids, or any animal Subſtance infuſed in it, as evidently appears by the Effects of Lime in dreſſing Skins, and by the Experiments formerly related; its Succeſs in the Cure of Fluxes and Dyſenteries, is no Proof of its being aſtringent, as *Galen* long ago evinced; who, in the *Latin* Edition I have, thus argues: *Quidam medicamenta nonnulla, ex eo quod diarrhœis aut dyſenteriis medentur, adſtringere ea colligunt, quanquam ne minimum habeant adſtrictionis; imo prorſum contra rarefacientia nimirum*

rum ſint & laxantia: cum alioqui quæ aſtringunt, corpora contrahant, condenſent, conſtipent, atque conſtringant. Nam adeps caprinus omnibus, quæ aut guſtu, aut facultate ſunt adſtringentia, adverſiſſimus eſt, veluti etiam farina triticea, & amylum, & innumera eorum, quæ vim habent, tum emplaſticam, tum mitigatoriam, atque acrimonias hebetandi, eaque ratione iis qui acria mordaciaque per alvum excernunt, auxiliantur. Sane eſto & oleum ex adſtringentium numero, quoniam ſæpius infuſum profuit. Gal. Simpl. l. 1. c. 34. But granting that Lime-water had both theſe Qualities, as ſome ſolid Subſtances, *e. g.* Filings of Iron, have, which in diſſolving checks Acidities, and being by them diſſolved, becomes ſtrongly aſtringent; yet it will not be eaſy to prove, that either Gout or Gravel depend on a predominating Acid; or that Filings of Iron, though an excellent Medicine for ſuch as have weak Stomachs, with a predominating Acid, is of equal Value with Lime-water in theſe Diſeaſes.

II. My good Friend and Colleague Dr *Whytt* publiſhed, in the *Medical Eſſays,* in 1743, an Eſſay towards the Diſcovery of a ſafe Medicine for diſſolving the Stone, which has done much Good in that melancholy Diſeaſe. It was conſiderably enlarged by the Author, and reprinted with the Eſſays in 1747; and in *Auguſt* laſt came out by itſelf, with many more Additions, and with this Title, *An Eſſay on the Virtues of Lime-water in the Cure of the Stone;* whereby it becomes more generally uſeful.

Here the Doctor (*q*) obſerves, that “ it is far from being true that Quick-lime is ſoon deprived of its Virtues by repeated Affuſions of Water, or that the third or fourth Water procured from it, is altogether inſipid, as ſome have affirmed.” And below he adds, “ That ſome Stone-lime, which had been reduced to a Powder, by being expoſed to the open Air for four Months, ſtill retained ſome of its Virtue, after having had, during the Courſe of ſixty Days, two hundred and ſixty times its Weight of Water poured upon it: And ſome

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(*q*) p. 43.

Lime-water procured from calcined Oiſter-ſhells, upon which, in forty-eight Days, he had poured two hundred and ſeventy times their Weight of Water, was, by Experiment, found to be poſſeſſed of a conſiderable Power of diſſolving the Stone."

When I communicated to not a few, what Quantity of Lime-water I had got from a Pound of Quick-lime, it was generally diſbelieved, and looked on as impoſſible; nor could the Doctor fully credit it till he made the above Experiments. And no wonder; for had it been told me before, I would probably have ſuſpended my Aſſent until I alſo had made the Trial. To convince Dr *Rutherford,* who is very deſervedly at the Head of our Faculty in the Univerſity, I ſent him a Bottle of the Lime-water, which the Pound of Stone Quick-lime, mentioned above, *p.* 28. N° 3. afforded, after about five hundred Pounds of Water had been poured on it: He was not a little ſurpriſed at its Strength, as he told me afterwards, and ſaid, there appeared to be ſomething very wonderful in it; for, by the Taſte, he would have taken it for the firſt Water. So I claim the Diſcovery; though Dr *Whytt* has not done me the Honour to mention me for it, probably becauſe his Experiments come not out the full Length of mine, though they fall not much ſhort of them.

For if "freſh calcined Shells impregnate Water more ſtrongly than ſuch as have had ſeveral Affuſions before; and if double Lime-water (that is, Lime-water made with calcined Shells hot from the Fire, rendered remarkably ſtronger by pouring it a ſecond time on freſh burnt Shells), ſtanding on the Shells a few Days, loſes ſome of its Virtue and Strength, while the weaker Lime-waters are conſtantly ſupplied with freſh Virtue from the Shells, ſufficient to make up what they loſe by the Contact of the Air *(r)*;" and yet Stone Quick-lime, after having been four Months expoſed to the open Air, and having had two hundred and ſixty times its Weight of Water poured upon it, ſtill retained

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(r) Vid. Eſſ. p. 41. and 42.

ſome of its Virtue; may it not be thought probable, conſidering the Influence of the Air on Quick-lime, and how much of what is diſſolvable, muſt have been thrown up in Cruſts, during four Months and ſixty Days, that if the Stone Quick-lime had been taken hot from the Lime-kill, it would have retained ſome of its Virtue, after having had many more (perhaps five hundred and twenty) times its Weight of Water poured on it? And can any Reaſon be aſſigned why the tenth or twentieth Water ſhould be weaker than the firſt, while there ſtill remains Virtue in the Lime, if it be not that Water can bear no more of it? Or that the ſame Quantity of the Lime diſſolved in the Water after ſeveral Affuſions, is not of the ſame Strength with that which the firſt Water takes up? And if this be the Fact, how comes there to be any Difference in their ſpecific Weights, when filtered?

As for ſpecific Gravities in general, I owned above how ſenſible I am of the Difficulty of determining them accurately; and referred to the very valuable Tables of Dr *Richard Davies*, in the *Phil. Tranſ.* N° 488. *p.* 436. to 489. Where that learned Gentleman has with great Pains, and no leſs ſolid Judgment, collected all the Experiments of that Kind, that have been made by the moſt accurate Authors, ſhewing how widely they diſagree, pointed out the Cauſes of ſuch Difference, *&c.* In a Word, he ſeems to have exhauſted that Subject. I cannot however but obſerve from theſe Tables, that, according to the great Mr *Boyle*, a Cubic Inch of Water weighs two hundred and fifty-ſix Troy Grains: But, according to the accurate Mr *Ward* of *Cheſter*, 253.18.; that is, Mr *Boyle*'s Water is to Mr *Ward*'s, as 64 to (63.295. or nearly) 63.3. And yet Mr *Boyle* (in his *Medicina Hydroſtatica*) ſays, "Having examined the Weight of divers Waters, I found the Difference between their ſpecific Gravities far leſs than almoſt any body would expect; being but about one thouſandth part of the Weight of either, even between Waters, where one would expect a notable Diſparity. Nor did I find any Difference conſiderable between the Weight of Spring-water, River-water, Rain-water, and Snow-water, though this laſt was ſomewhat lighter than any of the reſt." Even by my imperfect Way of weighing in the Flaſk, I have found the full of it cold from the Fountain, thirty Grains heavier than what had ſtood ſome time in my Chamber. I therefore hope the Doctor will not be offended though I ſay, that

There appears to me to be ſome Miſtake in making any Lime-water, if filtered through gray Paper, to be to our Fountain-water as 169 to 168 *(ſ)*. For thus a hundred and ſixty-nine Grains of this Lime-water muſt not only contain a Grain of Lime, but alſo ſo lodged in the Water, as not to increaſe its Bulk; and conſequently three Ounces, or a thouſand four hundred and forty Grains of this Lime-water, muſt contain more than eight Grains and a half of Lime, though I could hardly account for the two Grains of calcarious Cruſts which that Quantity of any of my Lime-waters yielded *(t)*. And Dr *Langriſh*'s Pint of ſtrong Lime-water evaporated, ſhould have left, not ſixteen, but more than forty-one Grains of a calcarious Subſtance. But allowing the ſpecific Gravity of his ſtrongeſt Lime-water to have been to that of Water, as 286 to 285 *(u)*; and ſuppoſing an *Engliſh* Pint of Spring-water to weigh exactly one Pound Apothecaries Weight, and that the ſame Quantity of Dr *Langriſh*'s ſtrong Lime-water, would have weighed one Pound, and twenty-ſeven and a half Grains, by Miſtake for twenty-three and a half I ſuppoſe: is it at all probable, that Quick-lime, after long Calcination, will communicate to a Pint of Water eleven and a half (or ſeven and a half) Grains of ſuch a ſubtile active Matter, as muſt by Diſtillation, as well as by Evaporation, fly off from or with the Water, and evaniſh, or eſcape through the Luting or Pores of the Veſſels? This muſt be more ſubtile and volatile than a volatile alcaline Salt itſelf, which yet the Doctor

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(ſ) *Vid.* Eſſ. p 40.
(t) *Vid.* p. 7. 8. 9. *ſupra.*
(u) *Vid.* Eſſ. p. 66.

owns (*x*) would have been expelled by the Fire. Neither does it appear to me very probable, that ſuch ſubtile volatile Matter would increaſe the ſpecific Gravity of the Water. The Analogy between ſome mineral Waters and Lime-water (*y*) ſeems to explain nothing here: Their martial Spirit, as it is called, being an inflammable Sulphur; and if it increaſes the ſpecific Gravity of the Waters impregnated with it, it is more than I know.

Beſides, ſince Soap-leys (*z*) made by pouring two Pounds of boiling Water upon four Ounces of purified Potaſh, and five Ounces of calcined Oiſter-ſhells freſh from the Fire, and let ſtand twenty-four Hours, was neither ſo corroſive nor diſagreeable as the *Glaſgow* Soap-leys, and its ſpecific Gravity leſs by a twenty-fourth Part; while the diſſolving Power of the lighteſt was above one third ſtronger; the Shell Soap-ley diſſolving a Thirteen-grain Piece of a Calculus entirely in ten Hours warm Digeſtion; and the *Glaſgow* Soap-ley taking ſixteen Hours warm Infuſion to do the ſame. Hence (ſuppoſing the Quantity of the *Glaſgow* Soap-ley to have been the ſame with the other, and that the Doctor examined the Condition of the Calculus in it, after ten Hours warm Infuſion, though not mentioned here) one would think, that the ſpecific Weight of Shell Lime-water, could not be much greater than that of Stone Lime-water, nor its ſuperior lithontriptic Virtue be accounted for from its greater ſpecific Gravity (*a*). But whatever is in this,

That a general Poſition is not always well founded on a ſingle Experiment, might be proven by many Inſtances; but I need go no further than the Eſſay (*b*) for a notable one. For there the Author informs us, that " he found a Solution of *Alicant* Soap in Stone Lime-water had a greater diſſolving Power, than either

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(*x*) Eſſ. p. 65.
(*y*) Eſſ. p. 63.
(*z*) *Vid.* Eſſ. p. 84.
(*a*) *Vid.* Eſſ. p. 42.
(*b*) p. 89. & 90.

a Solution of Soap in common Water, or Lime-water by itſelf, or even than the Aggregate of the diſſolving Powers of Soap and Lime-water when unmixed:" And then relates the Experiment on which this Poſition is founded, which is as clear and concluſive as one Experiment can be. But in the following Paragraph he candidly owns, that at " another Time, when he made the ſame Experiment, he did not find the Virtue of the Lime-water ſo much increaſed by the Soap." I may therefore be allowed to relate an Experiment or two which I made.

I put into one Glaſs two Ounces of a very clean and apparently pure Potaſh, (of which cold Water left only a ſixteenth Part undiſſolved), and one Ounce of ſlaked Quick-lime; and into another Glaſs alſo two Ounces of the ſame Potaſh, and an Ounce of calcined Oiſter-ſhells, very white and brittle, and freſh from the Fire, but not hot; and poured on each two Gills of cold Water, in order to compare the Strength of theſe two Soap-leys; whereof let the firſt be A, and the laſt B. When they had ſtood twenty-four Hours, and been ſtirred and ſhaken ſeveral Times, I poured off and weighed a Gill of each as accurately as I could; and found A juſt four Ounces Troy; but B eighteen Grains lighter. Then having poured them into two different wide-mouthed Phials, I put into A a Fragment of a Calculus weighing twenty-five Grains; and another Fragment of the ſame Calculus of twenty-one Grains only, into B, and ſet both in a North Window. In about twelve Hours Time A became a little muddy round the Fragment; and after twenty-four Hours only, ſeveral little Bits of it were fallen off; while the Fragment in B diſcovered no Signs of Solution for two Days. After they had ſtood four Days and ſixteen Hours, I filtered A; and eight Hours after, B. And having with freſh Water waſhed away Part of the adhering Lixive, I dried both well, and weighed in the Papers, (which at firſt were exactly of the ſame Weight), and found the Paper A three Grains heavier than B: But carefully ſeparating the Remainders of the Fragments from the Papers, that of A weighed nine Grains, and that of B twelve Grains; A being in Powder and ſmall Bits, but B almoſt all in one Piece. This being a ſingle Experiment,

I repeated it; taking for one Ounce of the above Potaſh, half an Ounce of Stone Quick-lime, which I had kept ten Days by me, and was crumbling into Pieces: And for another Ounce of the Potaſh, a full Ounce of Oiſter-ſhells, calcined for five Hours very white; and becauſe they did not fall in Water, calcined a ſecond Time as long; and treating all as above; The firſt being called A, and the other B, as before; I weighed a Gill of each, and found A to want only four Grains of four Ounces Troy, (being three Ounces ſeven Drams and fifty-ſix Grains); but B wanted one Dram and twelve Grains of the four Ounces Troy, (being three Ounces ſix Drams and forty-four Grains); and ſo was ſixty-eight Grains lighter than A. The four Grains which A wanted of the four Ounces, I attribute to the Potaſh's being ſoftened a little by the Moiſture of the Air; and B's being ſo much lighter than it was in the former Experiment, to the greater Proportion of the Shell Quick-lime taken in this than in it. *See* above, *p.* 22. Theſe two Lixives being poured into the two Phials as before, I put into A ſeven Grains in two Fragments; and into B alſo ſeven Grains, but in four Fragments, of the ſame Calculus, which I uſed in the former Experiment. Theſe having ſtood forty-eight Hours, I filtered, and found the dried *reſiduum* of A two Grains and a half; and of B only one Grain and a half. Whether this is owing to the greater Proportion of the Quick-lime in B than in A, or there being four Fragments in the one more than the other, I leave the Reader to determine, or future Experiments.

I alſo infuſed one Fragment of the ſame Calculus, weighing ten Grains and a half, in a Gill and a half of double Shell Lime-water; and ten Grains of the ſame Calculus in two pretty equal Fragments, in a like Quantity of ſingle Stone Lime-water. After ten Days I filtered both; and being dried, the ſingle Fragment weighed ten Grains, and the two Fragments only eight Grains.

I ſhall make no Inferences; but only obſerve, that I chuſed to make this as well as all my Experiments, without any artificial Heat, not only becauſe I had not Conveniency for Furnaces, *&c.* but alſo becauſe I thought it not eaſy, with ſufficient Accuracy, to adjuſt and regulate the Fire, ſo as it might neither exceed nor fall below what it ought to be; either of which might mar the Experiment: And that therefore the comparative Power of Menſtruums, in many Caſes, was, with greateſt Certainty, diſcovered in the common Air. And thus,

By all the Experiments I made, I could neither diſcover any Difference in the Strength of the Lime-water, nor in the Quantity of the Cruſts it afforded, whether one Part of compleatly-calcined and recent Quick-lime had yielded ten, fifty, or five hundred Parts of Lime-water. But I know no body ever imagined, *(c)* "that Water acquires the ſame preciſe Degree of Strength, whatever be the Quantity of Quick-lime upon which it is poured; as is obſerved of Wine in which *Crocus metallorum* is infuſed." For neither can Quick-lime impregnate more than a certain Quantity of Water; nor *Crocus metallorum* more than a certain Quantity of Wine. But while that certain Quantity is not exceeded, I have not been able to diſcover, that either theſe Lime-waters, or antimonial Wines, differ in Strength; or any Reaſon why they ſhould differ. For, ſurely, if in any Caſe Analogy can furniſh an Argument, it is here. Every Menſtruum diſſolves only as much of any thing put into it as it can diſſolve, and no more by any means, in the ſame Degree of Heat. Water, for Inſtance, can take up only a certain Quantity of any Salt, or of whatever is diſſolvable in it. Dr *Grew* long ago obſerved this; who, among other Things, notices, that two Drams of Senna will impreg-

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(c) Vid. p. 41.

nate four Ounces of Water as ſtrongly, as if four Drams were infuſed in it *(d)*. The Lime-water (mentioned above, § 1. N° 7.) ſtill retains (at leaſt ſome of) the Qualities of Lime-water; it kills Inſects, gathers Cruſts, is detergent, *&c.* as at firſt. Now, if "Lime-water were ſtronger or weaker in proportion as a greater or leſs Quantity of Quick-lime is added to the Water, *&c. (e).*" Be this Proportion what it will, it muſt be very ſmall. For it cannot be ſaid, that the Strength of ſeven Pounds of Lime-water procured from two Pounds of Quick-lime, is twice as ſtrong as it would have been, if only one Pound of Quick-lime had been uſed. But I ſay, be the Proportion what it will, if this hold, Lime-water may be made of any Strength you pleaſe, at leaſt much ſtronger than was ever yet known. But to me it appears more probable, that Water can bear, or diſſolve only a certain Quantity of Quick-lime; and if there be as much of Quick-lime in it as will afford this Quantity, and ſufficient Time allowed, it will impregnate itſelf ſo fully as to be able to bear no more. And if there be ſuch a Quantity of Lime in the Water, as will, after two or more Waters, ſtill conſiderably impregnate freſh Water, I cannot conceive why the firſt Water ſhould leave in the Lime ſo much of its diſſolvable Part, and yet diſſolve any Part of new Quick-lime infuſed in it.

I ſaid this proportional Increaſe of Strength muſt be very ſmall, and I may add imperceptible. For if Lime-water procured from calcined Oiſter-ſhells, upon which, in forty-eight Days, had been poured two hundred and ſeventy times their Weight of Water, was nevertheleſs, by Experiment, found to be poſſeſſed of a conſiderable Power of diſſolving the Stone *(f)*; then theſe calcined Oiſter-ſhells, would probably have impregnated as ſtrongly, five or ſix hundred times their Weight of Water, as they did the two hundred and ſeventy, if it had been all poured on at once, or in a

ſhort

(d) *Vid. Grew*'s Experiments on the Solution of Salts in Water.

(e) *Vid.* Eſſ. p. 41.

(f) *Vid.* Eſſ. p. 43.

ſhort Time. And if the ſecond Water was weaker than the firſt, the third than the ſecond, and ſo on to the fiftieth or fifty-fourth Water, and yet this laſt conſiderably lithontriptic, their Decreaſe of Strength would not eaſily be perceived, nor determined, I think, without a greater Variety of Experiments than perhaps have yet been made.

I noticed above *(g)*, that ſlaked Lime makes an Ebullition in Spirit of Vinegar. This Ebullition, indeed, is not ſo violent as it is when the Cruſts are infuſed in the Spirit, but nevertheleſs viſible: And that ſome of the Lime is diſſolved in it, appears by the *quaſi* Vegetation which follows. As for the Experiments made in Vegetation with Quick-lime and Lime-water, too long to be related, I have given briefly the Event of them in the *Tyrocinium Botannicum.*

That Quick-lime, after being rendered *almoſt* inſipid by frequent Affuſions of Water, acquires its former Properties by a new Calcination *(h)*, is not to be doubted. But, perhaps, the almoſt inſipid Quick-lime was not diveſted of its Properties before Calcination. I once calcined ſome of the Lime-cruſts; but they could communicate nothing to Water. Another Time I made the ſame Experiment; and they did communicate ſomething, and yielded Lime-water; perhaps becauſe they were collected off the Water ſtanding on the Lime; and ſo might contain ſome Parts of the not exhauſted Quick-lime. I remember alſo, that *Van Leeuwenhoek* ſays, old Lime-rubbiſh may, by Calcination, be rendered Quick-lime. And I found, that ſome exhauſted Chalk-lime, upon Calcination, became really Quick-lime again, and afforded ſeveral Lime-waters. If this conſtantly hold, it is not improbable, that, by repeated Calcinations, all the Quick-lime may at laſt be rendered diſſolvable in Water. But whether the Cruſts which filtered Lime-water throws up, may by Calcination be again reduced to Quick-lime, I cannot yet determine.

(g) p. 15.
(h) Vid. Eſſ. p. 76.

To conclude: The Experiments which I made, are ſimple, and may eaſily be repeated by any body, without the Trouble of Lamp-furnaces, digeſtive or other artificial Heats, ſtatical Balances, or the like; and if it be found that they cannot ſupport the Inferences which I have drawn from them, I am willing to give them up

Errare eſt hominis, ſed non perſiſtere: ſæpe
Optimus eſt portus vertere conſilium.

APPENDIX.

HOW far Lime-water may be proper even in acute Diſtempers, I cannot yet determine. Only I have found it ſafe in feveriſh Colds; and its diluent and diuretic Qualities, ſeem to make it probable, that it may prove more uſeful in Fevers, than is at preſent believed; which the following Abſtract of two Letters from Mr *Robert Menzies*, M. C. confirms, who writes thus.

A Young Man of twenty-two, who had an Ague in *March* 1751, and continued ſtill valetudinary, was, in *Auguſt* following, ſeized with Pains in his Bones, Laſſitude, Nauſea, *&c.*; and on the ninth Day with a cold Fit; after which he turned hot and feveriſh, and I was ſent for. I gave him an Ipecacoan Vomit, which brought up a great deal of rough Phlegm and Bile; yet he continued very ſick, feveriſh, and weak. An Infuſion of Poppy-heads and Spear-mint ſettled his Stomach a little; but a violent Looſeneſs came on, and continued till next Night, accompanied with violent Colic-pains and Gripes. Next Morning he complained of Pains in his Loins, Groins, and about the Penis, of a Numbneſs in his Thighs and Nauſea, and made little or no Urine; which made me ſuſpect a *Nephritis*, and I determined to blood him: But ſeeing the Blood ſo poor and thin as ſcarcely to colour my Finger, I ſoon ſtopt it; and though I did not take above three Ounces, he fainted; was more weakened by

it,